Fukushima Daiichi Accident Study Information Portal

Public Content Report

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Fukushima Daiichi Accident Study Information Portal

Idaho National Laboratory
Oak Ridge National Laboratory
Sandia National Laboratories

Introduction

The accident at the Fukushima Daiichi nuclear power station in Japan is one of the most serious in commercial nuclear power plant operating history. As its story unfolds, much will be learned that may be applicable to the U.S. reactor fleet, nuclear fuel cycle facilities and supporting systems, and the international reactor fleet. For example, lessons from Fukushima may be applied to emergency response planning, reactor operator training, accident scenario modeling, human factors engineering, radiation protection, and accident mitigation; as well as influence U.S. policies towards the nuclear fuel cycle including power generation, and spent fuel storage, reprocessing, and disposal.

The NRC and DOE NE have agreed to jointly sponsor an accident reconstruction study. The study team will include subject matter experts from Idaho National Laboratory (INL), Oak Ridge National Laboratory (ORNL), and Sandia National Laboratories (SNL).

The intent of this portal is to provide an approach to collecting, storing, retrieving, and validating information and data for use in reconstructing the Fukushima accidents and to assist the other team members by providing support for the technical basis behind the event reconstruction.

Unit 1 Timeline

Friday, March 11, 2011

12:00:00 PM Isolation Condenser - Actuation Train - IC A - Standby
12:00:00 PM High Pressure Coolant Injection - Turbine driven pump - HPCI - Standby
12:00:00 PM Service Water System - Motor driven pump - CCSW - Operating
12:00:00 PM DC Power - Battery - 125 V Battery - Operating
12:00:00 PM Power Conversion - Main steam isolation valve - MSIVs - Normally Open; Not failed
12:00:00 PM Offsite Electrical Power - System level event - Offsite Power Sources - Operating
12:00:00 PM Reactor Protection - Actuation Train - Reactor - Operating
12:00:00 PM AC Power System - Emergency diesel generator - EDG 2 - Standby
12:00:00 PM AC Power System - Emergency diesel generator - EDG 1 - Standby
2:46:00 PM Earthquake (Tohoku)
2:46:00 PM Unit 1 Shut Down
2:46:01 PM Reactor Protection - Actuation Train - Reactor - Reactor Scram
2:47:00 PM Offsite Electrical Power - System level event - Offsite Power Sources - No power-loss of power
2:47:00 PM Power Conversion - Main steam isolation valve - MSIVs - Normally open; fail in closed position
2:47:00 PM AC Power System - Emergency diesel generator - EDG 2 - Automatically Started
2:47:00 PM AC Power System - Emergency diesel generator - EDG 1 - Automatically Started
2:47:00 PM Loss of Offsite Power
2:52:00 PM Isolation Condenser - Actuation Train - IC B - Automatically Started
2:52:00 PM Isolation Condenser - Actuation Train - IC A - Automatically Started
3:02:00 PM Unit 1 subcriticality confirmed
3:03:00 PM Isolation Condenser - Actuation Train - IC B - Manually Shutdown
3:03:00 PM Isolation Condenser - Actuation Train - IC A - Manually Shutdown
3:27:00 PM 1st Tsunami wave hits unit 1
3:35:00 PM 2nd Tsunami wave hits unit 1
3:37:00 PM High Pressure Coolant Injection - Turbine driven pump - HPCI - Fail to start
3:37:00 PM Service Water System - Motor driven pump - CCSW - Fail to continue running
3:37:00 PM DC Power - Battery - 125 V Battery - Fail to operate
3:37:00 PM AC Power System - Emergency diesel generator - EDG 2 - Fail to continue running
3:37:00 PM AC Power System - Emergency diesel generator - EDG 1 - Fail to continue running
3:37:00 PM Station Blackout, Unit 1
5:30:00 PM Firewater Injection - Engine driven pump - Diesel driven fire pump - Manually Started
6:18:00 PM Isolation Condenser - Actuation Train - IC A - Manually Started
6:25:00 PM Isolation Condenser - Actuation Train - IC A - Manually Shutdown
8:07:00 PM Reactor pressure checked locally in reactor building, 1015 psia

8:49:00 PM MCR lit by temporary lighting
9:30:00 PM Isolation Condenser - Actuation Train - IC A - Manually Started
11:50:00 PM Restoration team provides temp power to MCR. D/W pressure 87 psia (600 kPaa)

Saturday, March 12, 2011

1:48:00 AM Firewater Injection - Engine driven pump - Diesel driven fire pump - Fail to continue running
2:30:00 AM Drywell pressure had increased to 122 psia (.84 MPaa).
2:45:00 AM Reactor pressure checked, 131 psia (901 kPaa)
4:19:00 AM Drywell pressure lowered and stabilized without venting to 113 psia(.78 MPaa)
5:46:00 AM Firewater Injection - Engine driven pump - Fire Engine - Manually Started
11:00:00 AM Isolation Condenser - Actuation Train - IC A - Fail to continue running
2:30:00 PM Containment Vent - Air operated valve - S/C Large vent valve - Manually Opened
2:30:00 PM Venting Suppression Chamber began
2:50:00 PM Drywell pressure decreases, indicating venting successful.
2:53:00 PM Firewater Injection - Engine driven pump - Fire Engine - Loss of function
3:36:00 PM Hydrogen Explosion
7:04:00 PM Firewater Injection - Engine driven pump - Fire Engine - Manually Started
8:45:00 PM Boric acid added to seawater

Unit 2 Timeline

Friday, March 11, 2011

12:00:00 PM High Pressure Coolant Injection - Turbine driven pump - HPCI - Standby
12:00:00 PM Residual Heat Removal Service Water - Motor driven pump - RHRS - Standby
12:00:00 PM Service Water System - Motor driven pump - CCSW - Operating
12:00:00 PM DC Power - Battery - 125 V Battery - Operating
12:00:00 PM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system - Standby
12:00:00 PM Offsite Electrical Power - System level event - Offsite Power Sources - Operating
12:00:00 PM Power Conversion - Main steam isolation valve - MSIVs - Normally Open; Not failed
12:00:00 PM Reactor Protection - Actuation Train - Reactor - Operating
12:00:00 PM AC Power System - Emergency diesel generator - EDG 2 - Standby
12:00:00 PM AC Power System - Emergency diesel generator - EDG 1 - Standby
2:46:00 PM Earthquake (Tohoku)
2:47:00 PM Offsite Electrical Power - System level event - Offsite Power Sources - No power-loss of power
2:47:00 PM Power Conversion - Main steam isolation valve - MSIVs - Normally open; fail in closed position
2:47:00 PM Reactor Protection - Actuation Train - Reactor - Reactor Scram
2:47:00 PM AC Power System - Emergency diesel generator - EDG 2 - Automatically Started
2:47:00 PM AC Power System - Emergency diesel generator - EDG 1 - Automatically Started
2:47:00 PM Loss of Offsite Power
2:47:00 PM Unit 2 Shutdown
2:50:00 PM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system - Manually Started
2:51:00 PM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system - Automatically Shutdown
3:00:00 PM Residual Heat Removal Service Water - Motor driven pump - RHRS - Manually Started
3:01:00 PM Unit 2 subcriticality confirmed
3:02:00 PM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system - Manually Started
3:07:00 PM Torus cooling placed in service
3:25:00 PM Torus spray placed in service
3:27:00 PM 1st Tsunami wave hits unit 2
3:28:00 PM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system - Automatically Shutdown
3:35:00 PM 2nd Tsunami wave hits unit 2
3:39:00 PM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system - Manually

Started
3:41:00 PM High Pressure Coolant Injection - Turbine driven pump - HPCI - Fail to start
3:41:00 PM Residual Heat Removal Service Water - Motor driven pump - RHRS - Fail to continue running
3:41:00 PM Service Water System - Motor driven pump - CCSW - Fail to continue running
3:41:00 PM DC Power - Battery - 125 V Battery - Fail to operate
3:41:00 PM AC Power System - Emergency diesel generator - EDG 2 - Fail to continue running
3:41:00 PM AC Power System - Emergency diesel generator - EDG 1 - Fail to continue running
3:41:00 PM Station Blackout, Unit 2
8:49:00 PM MCR lit by temporary lighting
9:50:00 PM Reactor water level 3,400 mm > TAF
11:25:00 PM Drywell pressure indication restored. DW pressure 20 psia (.141 MPaa)

Saturday, March 12, 2011
2:00:00 AM RCIC verified to be operating
4:20:00 AM RCIC suction swapped (CST to torus)

Monday, March 14, 2011
1:18:00 PM Reactor water level 2400 mm > TAF
1:25:11 PM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system - Fail to continue running
4:43:00 PM Below Top of Active Fuel (TAF)
5:12:00 PM Reactor Pressure 1088 psia, too high for seawater injection
5:17:00 PM Reactor water level decreased to TAF
6:03:00 PM Reactor depressurization begins
6:06:00 PM Main Steam - Safety relief valve - SRV - Manually Opened
6:30:00 PM Firewater Injection - Engine driven pump - Fire Engine - Manually Started
7:03:00 PM Reactor pressure stabilizes following depressurization
7:20:00 PM Firewater Injection - Engine driven pump - Fire Engine - Fail to continue running
7:54:00 PM Firewater Injection - Engine driven pump - Fire Engine - Manually Started
9:03:00 PM Reactor pressure increasing
9:20:00 PM Main Steam - Safety relief valve - SRV - Manually Opened
10:50:00 PM Drywell pressure exceeds design pressure

Tuesday, March 15, 2011
12:45:00 AM Injection not likely at this pressure
6:00:00 AM Loud Noise Reported
11:25:00 AM Drywell pressure decreased, likely related to loud noise heard at 0600

Unit 3 Timeline

Friday, March 11, 2011

12:00:00 PM DC Power - Battery - 125 V Battery - Operating
12:00:00 PM High Pressure Coolant Injection - Turbine driven pump - HPCI - Standby
12:00:00 PM Residual Heat Removal Service Water - Motor driven pump - RHRS - Standby
12:00:00 PM Service Water System - Motor driven pump - CCSW - Operating
12:00:00 PM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system - Standby
12:00:00 PM Power Conversion - Main steam isolation valve - MSIVs - Normally Open; Not failed
12:00:00 PM Offsite Electrical Power - System level event - Offsite Power Sources - Operating
12:00:00 PM Reactor Protection - Actuation Train - Reactor - Operating
12:00:00 PM AC Power System - Emergency diesel generator - EDG 2 - Standby
12:00:00 PM AC Power System - Emergency diesel generator - EDG 1 - Standby
2:46:00 PM Earthquake (Tohoku)
2:47:00 PM Offsite Electrical Power - System level event - Offsite Power Sources - No power-loss of power
2:47:00 PM Reactor Protection - Actuation Train - Reactor - Reactor Scram
2:47:00 PM AC Power System - Emergency diesel generator - EDG 2 - Automatically Started
2:47:00 PM AC Power System - Emergency diesel generator - EDG 1 - Automatically Started
2:47:00 PM Loss of Offsite Power
2:47:00 PM Unit 3 Shutdown
2:48:00 PM Power Conversion - Main steam isolation valve - MSIVs - Normally open; fail in closed position
2:54:00 PM Unit 3 subcriticallity confirmed
3:05:00 PM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system - Manually Started
3:25:00 PM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system - Automatically Shutdown
3:27:00 PM 1st Tsunami Wave hits Unit 3
3:35:00 PM 2nd Tsunami Wave hits unit 3
3:38:00 PM Station Blackout, Unit 3
3:41:00 PM Residual Heat Removal Service Water - Motor driven pump - RHRS - Fail to start
3:41:00 PM Service Water System - Motor driven pump - CCSW - Fail to continue running
3:41:00 PM AC Power System - Emergency diesel generator - EDG 2 - Fail to continue running
3:41:00 PM AC Power System - Emergency diesel generator - EDG 1 - Fail to continue running
4:03:00 PM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system - Manually Started
9:58:00 PM Temporary lighting for unit 3 MCR

Saturday, March 12, 2011

11:36:00 AM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system - Fail to continue running
12:10:00 PM Primary pressure had slowly increased to 57 psia (0.39 MPaa)
12:35:00 PM High Pressure Coolant Injection - Turbine driven pump - HPCI - Automatically Started
9:30:00 PM DC Power - Battery - 125 V Battery - Fail to operate

Sunday, March 13, 2011

2:42:00 AM High Pressure Coolant Injection - Turbine driven pump - HPCI - Fail to continue running
5:00:00 AM Reactor Pressure had increased to 1,085 psia (7.48 MPa abs).
7:45:00 AM Drywell pressure had increased to 67 psia (.46 Mpaa)
9:08:00 AM Main Steam - Safety relief valve - SRV - Manually Opened
9:20:00 AM Containment Vent - Air operated valve - S/C Large vent valve - Manually Opened
9:20:00 AM Venting determined to have started.
9:24:00 AM Drywell Pressure lowering, venting successful.
9:25:00 AM Firewater Injection - Engine driven pump - Fire Engine - Manually Started
11:17:00 AM Containment Vent - Air operated valve - S/C Large vent valve - Normally closed; fail in the closed position
12:20:00 PM Firewater Injection - Engine driven pump - Fire Engine - Fail to continue running
12:30:00 PM Containment Vent - Air operated valve - S/C Large vent valve - Manually Opened
1:12:00 PM Firewater Injection - Engine driven pump - Fire Engine - Manually Started
3:00:00 PM Containment Vent - Air operated valve - S/C Large vent valve - Normally closed; fail in the closed position
8:10:00 PM Containment Vent - Air operated valve - S/C Large vent valve - Manually Opened

Monday, March 14, 2011

1:00:00 AM Containment Vent - Air operated valve - S/C Large vent valve - Normally closed; fail in the closed position
1:10:00 AM Firewater Injection - Engine driven pump - Fire Engine - Fail to continue running
3:20:00 AM Firewater Injection - Engine driven pump - Fire Engine - Manually Started
6:10:00 AM S/C small vent valve opened
11:01:00 AM Firewater Injection - Engine driven pump - Fire Engine - Fail to continue running
11:01:00 AM Hydrogen Explosion
4:30:00 PM Firewater Injection - Engine driven pump - Fire Engine - Manually Started

Tuesday, March 15, 2011

4:05:00 PM Containment Vent - Air operated valve - S/C Large vent valve - Manually Opened

Unit 4 Timeline

Friday, March 11, 2011

- 12:00:00 PM Unit 4 Initial Condition
- 2:46:00 PM Earthquake (Tohoku)
- 2:47:00 PM Loss of Offsite Power
- 3:38:00 PM Station Blackout, Unit 4

Tuesday, March 15, 2011

- 6:00:00 AM Explosion in Unit 4 reactor building
- 6:00:00 AM Loud Noise Reported

Unit 5 Timeline

Friday, March 11, 2011

- 12:00:00 PM Initial Conditions of Unit 5
- 2:46:00 PM Earthquake (Tohoku)
- 2:47:00 PM Loss of Offsite Power
- 3:40:00 PM Station blackout, Unit 5

Sunday, March 20, 2011

- 2:30:00 PM Unit 5 Achieves Cold Shutdown

Unit 6 Timeline

Friday, March 11, 2011

- 12:00:00 PM Initial Conditions of Unit 6
- 2:46:00 PM Earthquake (Tohoku)
- 2:47:00 PM Loss of Offsite Power
- 3:40:00 PM EDG status after Tsunami

Sunday, March 20, 2011

- 7:27:00 PM Unit 6 achieves cold shutdown

Event Details

3/11/2011 12:00:00 PM Initial Conditions of Unit 5

Description: Unit 5 was in an outage with fuel assemblies in the core and RPV intact.
Applicable Locations: Unit5
Applicable Artifacts:

- Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety. Chapter iv.

3/11/2011 12:00:00 PM Initial Conditions of Unit 6

Description: Unit 6 was in an outage with all fuel assemblies loaded in the core and in cold shutdown mode.
Applicable Locations: Unit6
Applicable Artifacts:

- Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety. Chapter iv.

3/11/2011 12:00:00 PM Unit 4 Initial Condition

Description: Unit 4 was in an outage with the core offloaded to the spent fuel pool.
Applicable Locations: Unit4
Applicable Artifacts:

- Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety. Chapter iv.

3/11/2011 2:46:00 PM Earthquake (Tohoku)

Description: A major earthquake occurred located off the coast of the Miyagi Prefecture.
Cause: Earthquake
Applicable Locations: Unit1, Unit2, Unit3, Unit4, Unit5, Unit6, On-Site, Off-Site
Applicable Artifacts:

- Additional Report of the Japanese Government to the IAEA - The accident at TEPCO's Fukushima Nuclear Power Stations - (Second Report)

3/11/2011 2:46:00 PM Unit 1 Shut Down

Description: Reactor Scram, Turbine Trip, all control rods fully inserted.
Cause: Automated Action
Applicable Locations: Unit1
Applicable Artifacts:

- Chronology of Main Events at Fukushima Daiichi Nuclear Power Station

Unit 1 from Impact of Earthquake through Saturday, March 12

3/11/2011 2:47:00 PM Loss of Offsite Power
Description: Loss of all offsite power sources.
Cause: Loss of Power
Applicable Locations: Unit1, Unit2, Unit3, Unit4, Unit5, Unit6, On-Site, Off-Site
Applicable Artifacts:
- Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety. Chapter iv.

3/11/2011 2:47:00 PM Unit 2 Shutdown
Description: Reactor Scram, Turbine Trip, all control rods fully inserted.
Cause: Automated Action
Applicable Locations: Unit2
Applicable Artifacts:
- Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety. Chapter iv.

3/11/2011 2:47:00 PM Unit 3 Shutdown
Description: Reactor scram, turbine trip, all control rods fully inserted.
Cause: Automated Action
Applicable Locations: Unit3
Applicable Artifacts:
- Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety. Chapter iv.

3/11/2011 2:54:00 PM Unit 3 subcriticallity confirmed
Description: Unit 3 reactor verified subcritical
Cause: Operator Action
Applicable Locations: Unit3
Applicable Artifacts:
- Chronology of Main Events at Fukushima Daiichi Nuclear Power Station Unit 3 from Impact of Earthquake through Tuesday, March 15

3/11/2011 3:01:00 PM Unit 2 subcriticality confirmed
Description: Unit 2 reactor confirmed to be subcritical.
Cause: Operator Action
Applicable Locations: Unit2
Applicable Artifacts:

- Chronology of Main Events at Fukushima Daiichi Nuclear Power Station Unit 2 from Impact of Earthquake through Tuesday, March 15

3/11/2011 3:02:00 PM Unit 1 subcriticality confirmed
Description: Reactor subcriticality confirmed.
Cause: Operator Action
Applicable Locations: Unit1
Applicable Artifacts:
- Chronology of Main Events at Fukushima Daiichi Nuclear Power Station Unit 1 from Impact of Earthquake through Saturday, March 12

3/11/2011 3:07:00 PM Torus cooling placed in service
Description: Torus cooling manually started.
Cause: Operator Action
Applicable Locations: Unit2
Applicable Artifacts:
- Special Report on the Nuclear Accident at the Fukushima Daiichi Nuclear Power Station.

3/11/2011 3:25:00 PM Torus spray placed in service
Description: Torus spray manually started.
Cause: Operator Action
Applicable Locations: Unit2
Applicable Artifacts:
- Special Report on the Nuclear Accident at the Fukushima Daiichi Nuclear Power Station.

3/11/2011 3:27:00 PM 1st Tsunami wave hits unit 1
Description: Tsunami Wave generated by the earthquake strikes the plant
Cause: Earthquake
Applicable Locations: Unit1
Applicable Artifacts:
- Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety. Chapter iv.

3/11/2011 3:27:00 PM 1st Tsunami wave hits unit 2
Description: Tsunami Wave generated by the earthquake strikes the plant
Cause: Earthquake
Applicable Locations: Unit2
Applicable Artifacts:
- Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety.

Chapter iv.

3/11/2011 3:27:00 PM 1st Tsunami Wave hits Unit 3
Description: Tsunami Wave generated by the earthquake strikes the plant
Cause: Earthquake
Applicable Locations: Unit3
Applicable Artifacts:
- Additional Report of the Japanese Government to the IAEA - The accident at TEPCO's Fukushima Nuclear Power Stations - (Second Report)

3/11/2011 3:35:00 PM 2nd Tsunami wave hits unit 1
Description: Tsunami Wave generated by the earthquake strikes the plant
Cause: Earthquake
Applicable Locations: Unit1
Applicable Artifacts:
- Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety. Chapter iv.

3/11/2011 3:35:00 PM 2nd Tsunami wave hits unit 2
Description: Tsunami Wave generated by the earthquake strikes the plant
Cause: Earthquake
Applicable Locations: Unit2
Applicable Artifacts:
- Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety. Chapter iv.

3/11/2011 3:35:00 PM 2nd Tsunami Wave hits unit 3
Description: Tsunami Wave strikes plant
Cause: Earthquake
Applicable Locations: Unit3
Applicable Artifacts:
- Additional Report of the Japanese Government to the IAEA - The accident at TEPCO's Fukushima Nuclear Power Stations - (Second Report)

3/11/2011 3:37:00 PM Station Blackout, Unit 1
Description: Loss of off site and on site AC power sources
Cause: Tsunami Flooding
Applicable Locations: Unit1
Applicable Artifacts:

- Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety. Chapter iv.

3/11/2011 3:38:00 PM Station Blackout, Unit 3
Description: Loss of both offsite and onsite AC power sources.
Cause: Tsunami Flooding
Applicable Locations: Unit3
Applicable Artifacts:
- Fukushima Accident: An overview.

3/11/2011 3:38:00 PM Station Blackout, Unit 4
Description: Loss of all onsite and offsite AC power.
Cause: Tsunami Flooding
Applicable Locations: Unit4
Applicable Artifacts:
- Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety. Chapter iv.

3/11/2011 3:40:00 PM EDG status after Tsunami
Description: After the Tsunami flooding, EDGs 6A and 6H failed. EDG 6B continued to run and provided AC power.
Cause: Tsunami Flooding
Applicable Locations: Unit6
Applicable Artifacts:
- Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety. Chapter iv.

3/11/2011 3:40:00 PM Station blackout, Unit 5
Description: Loss of all onsite and offsite AC power sources.
Cause: Tsunami Flooding
Applicable Locations: Unit5
Applicable Artifacts:
- Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety. Chapter iv.

3/11/2011 3:41:00 PM Station Blackout, Unit 2
Description: Loss of off site and on site AC power.
Cause: Tsunami Flooding
Applicable Locations: Unit2

Applicable Artifacts:

- Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety. Chapter iv.

3/11/2011 8:49:00 PM MCR lit by temporary lighting

Description: Main Control Room lit by temporary lighting.
Cause: Operator Action
Applicable Locations: Unit1
Applicable Artifacts:

- Chronology of Main Events at Fukushima Daiichi Nuclear Power Station Unit 1 from Impact of Earthquake through Saturday, March 12

3/11/2011 8:49:00 PM MCR lit by temporary lighting

Description: Main control room lit by temporary lighting
Cause: Operator Action
Applicable Locations: Unit2
Applicable Artifacts:

- Chronology of Main Events at Fukushima Daiichi Nuclear Power Station Unit 2 from Impact of Earthquake through Tuesday, March 15

3/11/2011 9:50:00 PM Reactor water level 3,400 mm > TAF

Description: Reactor water level indication restored in control room. Vessel level indicated 3,400 mm above TAF.
Cause: Operator Action
Applicable Locations: Unit2
Applicable Artifacts:

- Special Report on the Nuclear Accident at the Fukushima Daiichi Nuclear Power Station.

3/11/2011 9:58:00 PM Temporary lighting for unit 3 MCR

Description: Temporary lighting established for unit 3 main control room using portable generator.
Cause: Operator Action
Applicable Locations: Unit3

3/12/2011 2:00:00 AM RCIC verified to be operating

Description: Workers verified RCIC pump discharge pressure in the field.
Cause: Operator Action
Applicable Locations: Unit2
Applicable Artifacts:

- Special Report on the Nuclear Accident at the Fukushima Daiichi Nuclear Power Station.

3/12/2011 4:20:00 AM RCIC suction swapped (CST to torus)

Description: RCIC suction was swapped from the CST to the torus.

Cause: Operator Action

Applicable Locations: Unit2

Applicable Artifacts:

- Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety. Chapter iv.

3/12/2011 2:30:00 PM Venting Suppression Chamber began

Description: Opened large suppression chamber vent valve with temporary air compressor. Release of radioactive material and decrease in containment pressure confirmed.

Cause: Operator Action

Applicable Locations: Unit1

Applicable Artifacts:

- Fukushima Daiichi Nuclear Power Station Unit 1 Circumstances of Venting of Containment Vessel

3/12/2011 3:36:00 PM Hydrogen Explosion

Description: Hydrogen Explosion in the Unit 1 Reactor Building

Cause: Explosion

Applicable Locations: Unit1

Applicable Artifacts:

- Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety. Chapter iv.
- Damage to unit 1 after hydrogen explosion

3/12/2011 8:45:00 PM Boric acid added to seawater

Description: Commenced adding boric acid to seawater injection

Cause: Operator Action

Applicable Locations: Unit1

Applicable Artifacts:

- Chronology of Main Events at Fukushima Daiichi Nuclear Power Station Unit 1 from Impact of Earthquake through Saturday, March 12

3/13/2011 9:20:00 AM Venting determined to have started.

Description: Venting determined to have successfully started due to decreasing containment pressure.

Cause: Operator Action

Applicable Locations: Unit3

Applicable Artifacts:

- Fukushima Daiichi Power Station Unit 3 Circumstances of Venting of Containment Vessel

3/14/2011 6:10:00 AM S/C small vent valve opened

Description: S/C small vent valve confirmed to have been opened, however containment pressure readings indicate little if any venting resulted.

Cause: Operator Action

Applicable Locations: Unit3

3/14/2011 11:01:00 AM Hydrogen Explosion

Description: Hydrogen Explosion in the Unit 3 Reactor Building

Cause: Explosion

Applicable Locations: Unit3

Applicable Artifacts:

- Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety. Chapter iv.
- Satellite image on March 14, 2011, at 11:04 am, three minutes after an explosion at Unit 3 (by Digital Globe).

Applicable Reviews:

- Review by: Shawn St. Germain Confidence Level: High
  Confidence high due to video taken at the time of the explosion.

3/14/2011 1:18:00 PM Reactor water level 2400 mm > TAF

Description: Reactor water level was 2400 mm above TAF and trending downward.

Cause: Operator Action

Applicable Locations: Unit2

Applicable Artifacts:

- Special Report on the Nuclear Accident at the Fukushima Daiichi Nuclear Power Station.

3/14/2011 5:17:00 PM Reactor water level decreased to TAF

Description: Indicated reactor water level decreased to TAF.

Cause: Loss of Power

Applicable Locations: Unit2

3/15/2011 6:00:00 AM Explosion in Unit 4 reactor building

Description: An explosion occured in the unit 4 reactor building. It is assumed to be caused by Hydrogen from venting unit 3.

Cause: Explosion

Applicable Locations: Unit4

Applicable Artifacts:

- Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety. Chapter iv.
- Additional Report of the Japanese Government to the IAEA - The accident at TEPCO's Fukushima Nuclear Power Stations - (Second Report)

3/15/2011 6:00:00 AM Loud Noise Reported

Description: A loud noise was heard. Possibly in the area of the torus (Unit 2) or from the explosions in Unit 4.

Cause: Unknown

Applicable Locations: Unit2, Unit4

Applicable Artifacts:

- Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety. Chapter iv.

3/20/2011 2:30:00 PM Unit 5 Achieves Cold Shutdown

Description: Unit 5 reaches cold shutdown conditions

Cause: Operator Action

Applicable Locations: Unit5

Applicable Artifacts:

- Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety. Chapter iv.

3/20/2011 7:27:00 PM Unit 6 achieves cold shutdown

Description: Unit 6 reaches cold shutdown conditions

Cause: Operator Action

Applicable Locations: Unit6

Applicable Artifacts:

- Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety. Chapter iv.

Artifact Details

Media File Artifacts

Description: Nuclear and Industrial Safety Agency (NISA) News Release
Source: NISA news release
File Name: en20110312-1.pdf

Description: The 2011 off the Pacific coast of Tohoku Pacific Earthquake and 4th April, 2011 the seismic damage to the NPPs.
Source: Japan Nuclear Energy Safety Organization (JNES)
File Name: 20110404 JNES Presentation.pdf

Description: Report of the Japanese Government to the IAEA Ministerial Conference on Nuclear Safety. Chapter iv.

Source: Nuclear Emergency Response Headquarters, Government of Japan, (June 2011)

File Name: chapter_iv_all.pdf

Description: Damage to unit 1 after hydrogen explosion
Source: ISIS
File Name: Damage to unit 1 after hydrogen explosion.jpg

Description: The Great East Japan Earthquake Expert Mission.
Source: IAEA
File Name: cn200_Final-Fukushima-Mission_Report.pdf

Description: Fukushima Accident: An overview.
Source: Akira Omoto, presentation.
File Name: ANS Omoto.pptx

Description: Additional Report of the Japanese Government to the IAEA - The accident at TEPCO's Fukushima Nuclear Power Stations - (Second Report)
Source: Second report from the Government of Japan to the IAEA (September 2011)
URL: http://www.meti.go.jp/english/earthquake/nuclear/iaea/iaea_110911.html

Description: INL Timeline data with injection rates
Source: Collection of timeline data from other sources
File Name: Fukushima Timeline Data with Injection Rates.pdf

Description: Chronology of Main Events at Fukushima Daiichi Nuclear Power Station Unit 1 from Impact of Earthquake through Saturday, March 12
Source: Tepco Report
File Name: 08102011 1F Timeline-unit1.pdf

Description: Fukushima Daiichi Nuclear Power Station Unit 1 State of Alternate Coolant Injection
Source: TEPCO Report
File Name: 08102011 1F Timeline-unit1 injection.pdf

Description: Fukushima Daiichi Nuclear Power Station Unit 1 Circumstances of Venting of Containment Vessel
Source: TEPCO Report
File Name: 08102011 1F Timeline-unit1 vent.pdf

Description: Chronology of Main Events at Fukushima Daiichi Nuclear Power Station Unit 2 from Impact of Earthquake through Tuesday, March 15
Source: TEPCO Report
File Name: 08102011 1F Timeline-unit2.pdf

Description: Fukushima Nuclear Power Station Unit 2 State of Alternate Coolant Injection
Source: TEPCO Report
File Name: 08102011 1F Timeline-unit2 injection.pdf

Description: Fukushima Daiichi Nuclear Power Station Unit 2 Circumstances of Venting of Containment Vessel
Source: TEPCO Report
File Name: 08102011 1F Timeline-unit2 vent.pdf

Description: Chronology of Main Events at Fukushima Daiichi Nuclear Power Station Unit 3 from Impact of Earthquake through Tuesday, March 15
Source: TEPCO Report

File Name: 08102011 1F Timeline-unit3.pdf

Description: Fukushima Daiichi Nuclear Power Station Unit 3 State of Alternate Coolant Injection
Source: TEPCO Report
File Name: 08102011 1F Timeline-unit3 injection.pdf

Description: Fukushima Daiichi Power Station Unit 3 Circumstances of Venting of Containment Vessel
Source: TEPCO Report
File Name: 08102011 1F Timeline-unit3 vent.pdf

Description: State of Immediate Response after Disaster Struck at Fukushima Daiichi Power Station
Source: TEPCO Report
File Name: 08102011 1F Timeline-general.pdf

Description: Radiation monitoring data for 3/14/11
Source: TEPCO
File Name: f1-mc-2011031424-e.xlsx

Description: Survey map of Fukushima Daiichi Nuclear Power Station on March 23, 2011
Source: TEPCO
File Name: f1-sv-20110323-e.pdf

Description: US DOE/NNSA Response to 2011 Fukushima Incident: Field Team Radiological Measurements
Source: US DOE
File Name: FieldMeasurements_DOE_1.xlsx

Description: Survey map of Fukushima Daiichi Nuclear Power Station on 3/31/11
Source: TEPCO
File Name: f1-sv-20110331-e.pdf

Description: Results of Airborne Monitoring by the Ministry of Education, Culture, Sports, Science and Technology and the U.S. Department of Energy (As of 4/29/11)
Source: MEXT and US DOE
File Name: 1304797_0506.pdf

Description: Review of Accident at Tokyo Electric Power Company Incorporated's Fukushima Daiichi Nuclear Power Station and Proposed Countermeasures (DRAFT)
Source: Japan Nuclear Technology Institute
File Name: Japan Nuclear Technology Institute Timeline.pdf

Description: Special Report on the Nuclear Accident at the Fukushima Daiichi Nuclear Power Station.
Source: INPO
File Name: 11_005_Special_Report_on_Fukushima_Daiichi_MASTER_11_08_11.pdf

Description: Satellite image on March 18, 2011, by Digital Globe.
Source: Digital Globe
Usage Information: www.digitalglobe.com/policies/usage
File Name: Fukushima_Daiichi_March_18_2011_digital_globe.jpg
URL:
http://www.digitalglobe.com/downloads/featured_images/09_japan_earthquaketsu_fukushima_daiichi_march18_2011_dg.jpg

Description: Satellite image on March 14, 2011, at 11:04 am, three minutes after an explosion at Unit 3 (by Digital Globe).
Source: Digital Globe
Usage Information: www.digitalglobe.com/policies/usage
File Name: Unit 1 and 3 after explosions - Digital Globe.jpg

Description: Fukushima Nuclear Accident Analysis Report (Interim Report)
Source: TEPCO report dated 12/2/11
File Name: Fukushima Nuclear Accidents Investigation Report (Interim) Main body.pdf

Description: Fukushima Nuclear Accident Analysis Report (Interim Report) Summary
Source: TEPCO Report dated 12/2/11
File Name: Fukushima Nuclear Accidents Investigation Report (Interim) Main body (Summary).pdf

Description: Fukushima Nuclear Accident Investigation Report (Interim Report - Supplementary Volume)
Source: TEPCO report dated 12/2/11

File Name: Fukushima Nuclear Accidents Investigation Report (Interim) Schedule (Individual Items).pdf

Description: The Nuclear Safety and Quality Assurance Meeting's Accident Investigation Verification Committee
Source: TEPCO report dated November 2011
File Name: Opinions from Nuclear Safety and Quality Assurance Meeting Accident Investigation Verification Committee.pdf

Description: Examination of Accident at Tokyo Electric Power Co., Inc.'s Fukushima Daiichi Nuclear Power Station and Proposal of Countermeasures
Source: Japan Nuclear Technology Institute (JANTI)
File Name: JANTI Fukushima Report - October 2011.pdf
URL: http://www.gengikyo.jp/english/shokai/Tohoku_Jishin/report.pdf

Description: Fukushima Daiichi –A One Year Review from TEPCO
Source: TEPCO web site March 14, 2012

File Name: Fukushima Daiichi - A One Year Review.pdf
URL: http://www.tepco.co.jp/en/nu/fukushima-np/review/index-e.html

Description: Volume of water injected into reactors (estimation)
Source: TEPCO data
File Name: 110613sanko_table_tyusui-e.pdf

Description: The Official report of The Fukushima Nuclear Accident Independent Investigation Commission
Source: The National Diet of Japan
File Name: Fukushima Accident Analysis Report July 2012.pdf

Description: Updated event timeline information for unit 1.
Source: TEPCO
File Name: (1)_eventdata(Unit1) 20nov12rev.1.0.xlsx

Description: Updated Component state data
Source: TEPCO

File Name: (2)_component state(Unit1).xls

Description: Updated water injection data for units 1,2 and 3
Source: TEPCO
File Name: (3)-1_water injection amount to RPV.xls

Description: Detailed description of injection by fire engines for units 1,2 and 3
Source: TEPCO
File Name: (3)-2_out line of water injection by fire engine.pdf

Description: Decay heat evaluation report
Source: TEPCO
File Name: (4)-2_description of decay heat and inventory.doc

Description: Updated reactor water level and pressure data for unit 1
Source: TEPCO
File Name: (5)-1_water level and pressure(Unit1).xls

Description: Updated temperature data for unit 1
Source: TEPCO
File Name: (5)-2_parameters of temperature(unit1).xls

Description: Parameter data strip charts unit 1
Source: TEPCO
File Name: (6)_chart(unit1).pdf

Description: Transient recorder data unit 1
Source: TEPCO
File Name: (7)-4_transient recorder(unit1).pdf

Description: Unit 1 plant specifications
Source: TEPCO
File Name: 1F_Plant_specifications_revised_19dec12rev.1.3.xlsx

Description: Updated component state data unit 2
Source: TEPCO

File Name: (2)_component state(Unit2).xls

Description: Updated event timeline data unit 2
Source: TEPCO
File Name: IAE_Okada_(1)_eventdata(Unit2) 20nov12Rev.1.0.xlsx

Description: Updated water level and pressure data unit 2
Source: TEPCO
File Name: (5)-1_water level and pressureüiunit2ujr1.xls

Description: Updated temperature data unit 2
Source: TEPCO
File Name: (5)-2_temperature(unit2).xls

Description: Parameter chart recorder data unit 2
Source: TEPCO
File Name: (6)_chart(unit2).pdf

Description: Transient recorder data unit 2
Source: TEPCO
File Name: (7)-4_transient recorder(unit2).pdf

Description: Updated event timeline data unit 3
Source: TEPCO
File Name: IAE_Okada_(1)_eventdata(Unit3) 20nov12Rev.1.0.xlsx

Description: Updated component state data unit 3
Source: TEPCO
File Name: (2)_component state(Unit3).xls

Description: Updated water level and pressure data unit 3
Source: TEPCO
File Name: (5)-1_water level and pressureüiunit3uj.xls

Description: Updated temperature data unit 3
Source: TEPCO

File Name: (5)-2_temperature(unit3).xls

Description: Chart recorder parameter data unit 3
Source: TEPCO
File Name: (6)_chart(unit3).pdf

Description: Transient recorder data unit 3
Source: TEPCO
File Name: (7)-3_transient recorder(unit3).pdf

Description: Unit 1 Reactor Building radiation survey map 2/14/13
Source: TEPCO
File Name: f1-sv3-20130315-e.pdf

Component State Artifacts

Unit1 Component States

DC Power (DCP), Battery (BAT), 125 V Battery
3/11/2011 12:00:00 PM to 3/11/2011 3:37:00 PM Operating
3/11/2011 3:37:00 PM to 8/1/2011 11:59:00 PM Fail to operate

Service Water System (SWS), Motor driven pump (MDP), CCSW
3/11/2011 12:00:00 PM to 3/11/2011 3:37:00 PM Operating
3/11/2011 3:37:00 PM to 8/1/2011 11:59:00 PM Fail to continue running

Firewater Injection (FW1), Engine driven pump (EDP), Diesel driven fire pump
3/11/2011 5:30:00 PM to 3/12/2011 1:48:00 AM Manually Started
3/12/2011 1:48:00 AM to 6/1/2011 12:00:00 AM Fail to continue running

AC Power System (ACP), Emergency diesel generator (DGN), EDG 1
3/11/2011 12:00:00 PM to 3/11/2011 2:46:00 PM Standby
3/11/2011 2:47:00 PM to 3/11/2011 3:37:00 PM Automatically Started
3/11/2011 3:37:00 PM to 8/1/2011 11:59:00 PM Fail to continue running

AC Power System (ACP), Emergency diesel generator (DGN), EDG 2
3/11/2011 12:00:00 PM to 3/11/2011 2:46:00 PM Standby
3/11/2011 2:47:00 PM to 3/11/2011 3:37:00 PM Automatically Started
3/11/2011 3:37:00 PM to 8/1/2011 11:59:00 PM Fail to continue running

Firewater Injection (FW1), Engine driven pump (EDP), Fire Engine
3/12/2011 5:46:00 AM to 3/12/2011 2:53:00 PM Manually Started
3/12/2011 2:53:00 PM to 3/12/2011 7:04:00 PM Loss of function
3/12/2011 7:04:00 PM to 8/1/2011 12:00:00 AM Manually Started

High Pressure Coolant Injection (HCI), Turbine driven pump (TDP), HPCI
3/11/2011 12:00:00 PM to 3/11/2011 3:37:00 PM Standby
3/11/2011 3:37:00 PM to 8/1/2011 11:59:00 PM Fail to start

Isolation Condenser (ICS), Actuation Train (ACT), IC A
3/11/2011 12:00:00 PM to 3/11/2011 2:52:00 PM Standby
3/11/2011 2:52:00 PM to 3/11/2011 3:03:00 PM Automatically Started
3/11/2011 3:03:00 PM to 3/11/2011 6:18:00 PM Manually Shutdown
3/11/2011 6:18:00 PM to 3/11/2011 6:25:00 PM Manually Started

3/11/2011 6:25:00 PM to 3/11/2011 9:30:00 PM Manually Shutdown
3/11/2011 9:30:00 PM to 3/12/2011 11:00:00 AM Manually Started
3/12/2011 11:00:00 AM to 8/1/2011 11:59:00 PM Fail to continue running

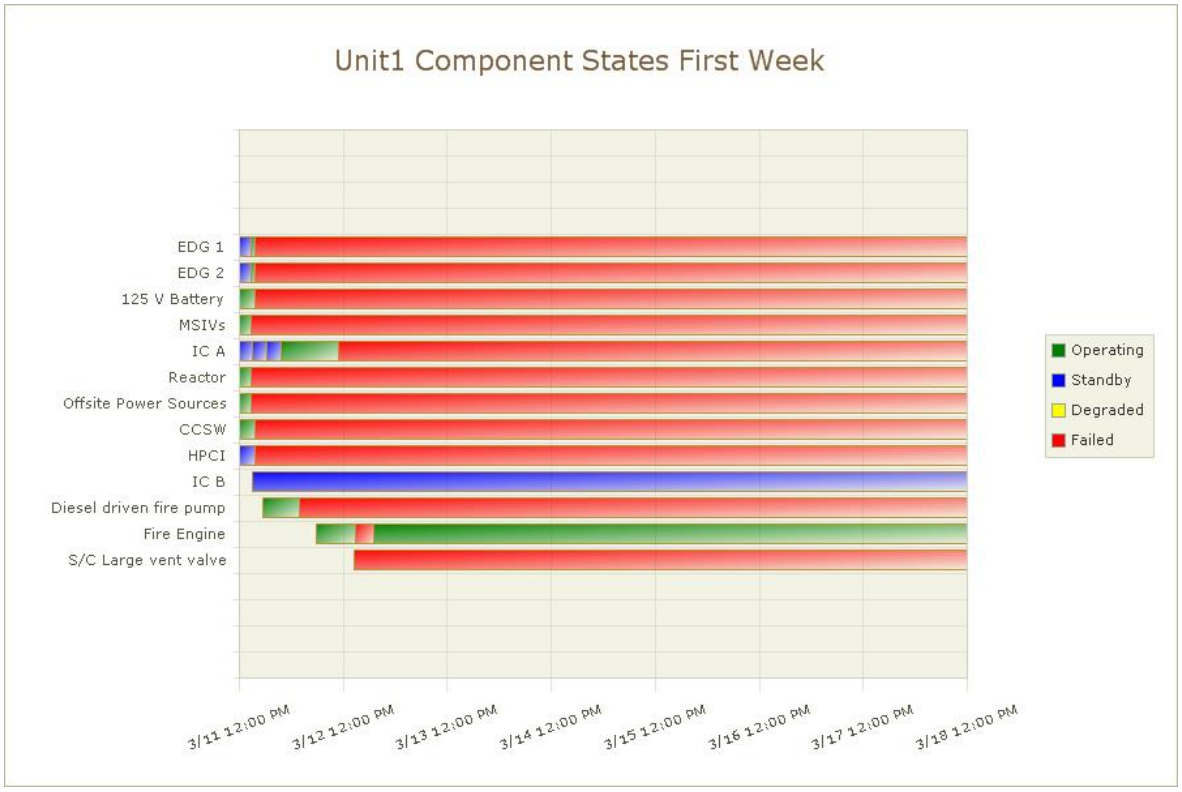
Isolation Condenser (ICS), Actuation Train (ACT), IC B
3/11/2011 2:52:00 PM to 3/11/2011 3:03:00 PM Automatically Started
3/11/2011 3:03:00 PM to 8/30/2011 12:00:00 AM Manually Shutdown

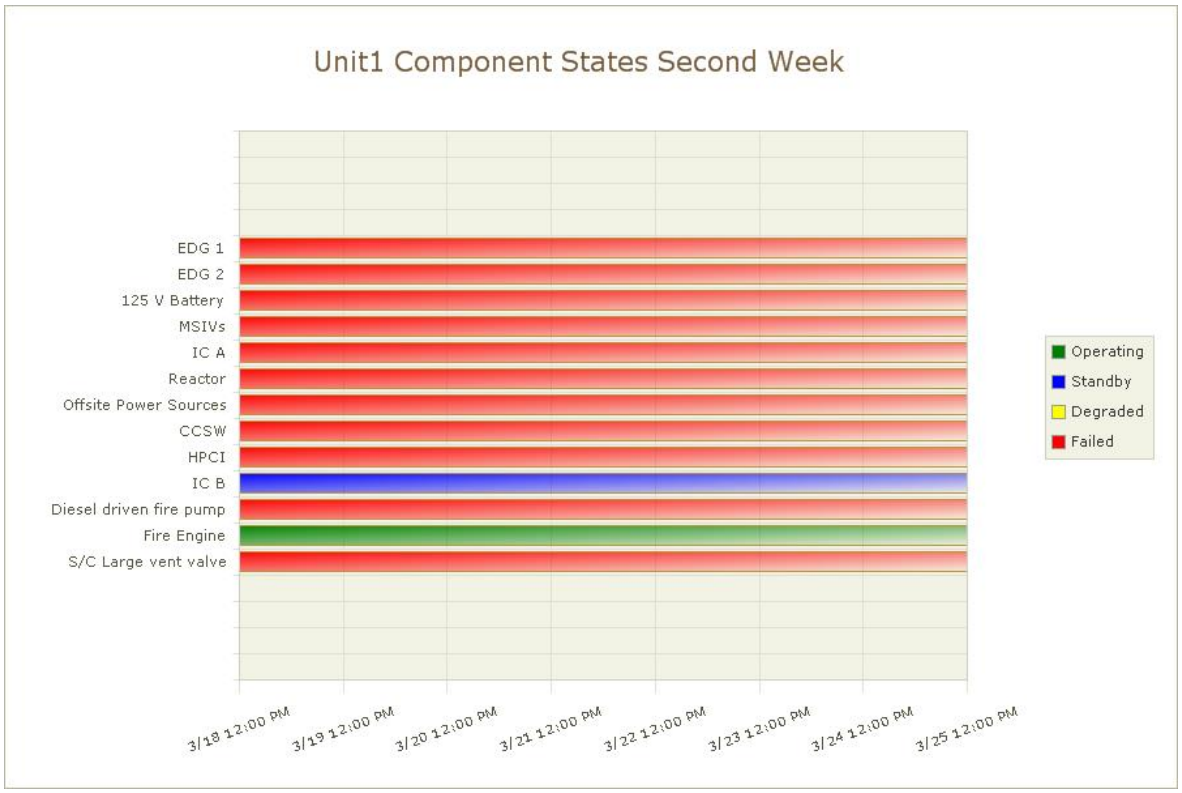
Power Conversion (PCS), Main steam isolation valve (MSV), MSIVs
3/11/2011 12:00:00 PM to 3/11/2011 2:47:00 PM Normally Open; Not failed
3/11/2011 2:47:00 PM to 8/1/2011 3:41:00 PM Normally open; fail in closed position

Offsite Electrical Power (OEP), System level event (SYS), Offsite Power Sources
3/11/2011 12:00:00 PM to 3/11/2011 2:47:00 PM Operating
3/11/2011 2:47:00 PM to 8/1/2011 11:59:00 PM No power-loss of power

Reactor Protection (RPS), Actuation Train (ACT), Reactor
3/11/2011 12:00:00 PM to 3/11/2011 2:46:00 PM Operating
3/11/2011 2:46:01 PM to 8/1/2011 11:59:00 PM Reactor Scram

Containment Vent (CVS), Air operated valve (AOV), S/C Large vent valve
3/12/2011 2:30:00 PM to 3/31/2011 12:00:00 PM Manually Opened


Unit1 Component States First Week
EDG 1
EDG 2
125 V Battery
MSIVs
IC A
Reactor
Offsite Power Sources
CCSW
HPCI
IC B
Diesel driven fire pump
Fire Engine
S/C Large vent valve
3/11 12:00 PM
3/12 12:00 PM
3/13 12:00 PM
3/14 12:00 PM
3/15 12:00 PM
3/16 12:00 PM
3/17 12:00 PM
3/18 12:00 PM
Operating
Standby
Degraded
Failed


Unit1 Component States Second Week
EDG 1
EDG 2
125 V Battery
MSIVs
IC A
Reactor
Offsite Power Sources
CCSW
HPCI
IC B
Diesel driven fire pump
Fire Engine
S/C Large vent valve
3/18 12:00 PM
3/19 12:00 PM
3/20 12:00 PM
3/21 12:00 PM
3/22 12:00 PM
3/23 12:00 PM
3/24 12:00 PM
3/25 12:00 PM
Operating
Standby
Degraded
Failed

Unit2 Component States

DC Power (DCP), Battery (BAT), 125 V Battery
3/11/2011 12:00:00 PM to 3/11/2011 3:41:00 PM Operating
3/11/2011 3:41:00 PM to 8/1/2011 11:59:00 PM Fail to operate

Service Water System (SWS), Motor driven pump (MDP), CCSW
3/11/2011 12:00:00 PM to 3/11/2011 3:41:00 PM Operating
3/11/2011 3:41:00 PM to 8/1/2011 11:59:00 PM Fail to continue running

AC Power System (ACP), Emergency diesel generator (DGN), EDG 1
3/11/2011 12:00:00 PM to 3/11/2011 2:47:00 PM Standby
3/11/2011 2:47:00 PM to 3/11/2011 3:37:00 PM Automatically Started
3/11/2011 3:41:00 PM to 8/1/2011 11:59:00 PM Fail to continue running

AC Power System (ACP), Emergency diesel generator (DGN), EDG 2
3/11/2011 12:00:00 PM to 3/11/2011 2:47:00 PM Standby
3/11/2011 2:47:00 PM to 3/11/2011 3:37:00 PM Automatically Started
3/11/2011 3:41:00 PM to 8/1/2011 11:59:00 PM Fail to continue running

Firewater Injection (FW1), Engine driven pump (EDP), Fire Engine
3/14/2011 6:30:00 PM to 3/14/2011 7:20:00 PM Manually Started
3/14/2011 7:20:00 PM to 3/14/2011 7:54:00 PM Fail to continue running
3/14/2011 7:54:00 PM to 8/1/2011 12:00:00 PM Manually Started

High Pressure Coolant Injection (HCI), Turbine driven pump (TDP), HPCI
3/11/2011 12:00:00 PM to 3/11/2011 3:41:00 PM Standby
3/11/2011 3:41:00 PM to 8/1/2011 11:59:00 PM Fail to start

Power Conversion (PCS), Main steam isolation valve (MSV), MSIVs
3/11/2011 12:00:00 PM to 3/11/2011 2:47:00 PM Normally Open; Not failed
3/11/2011 2:47:00 PM to 8/1/2011 3:41:00 PM Normally open; fail in closed position

Offsite Electrical Power (OEP), System level event (SYS), Offsite Power Sources
3/11/2011 12:00:00 PM to 3/11/2011 2:47:00 PM Operating
3/11/2011 2:47:00 PM to 8/1/2011 11:59:00 PM No power-loss of power

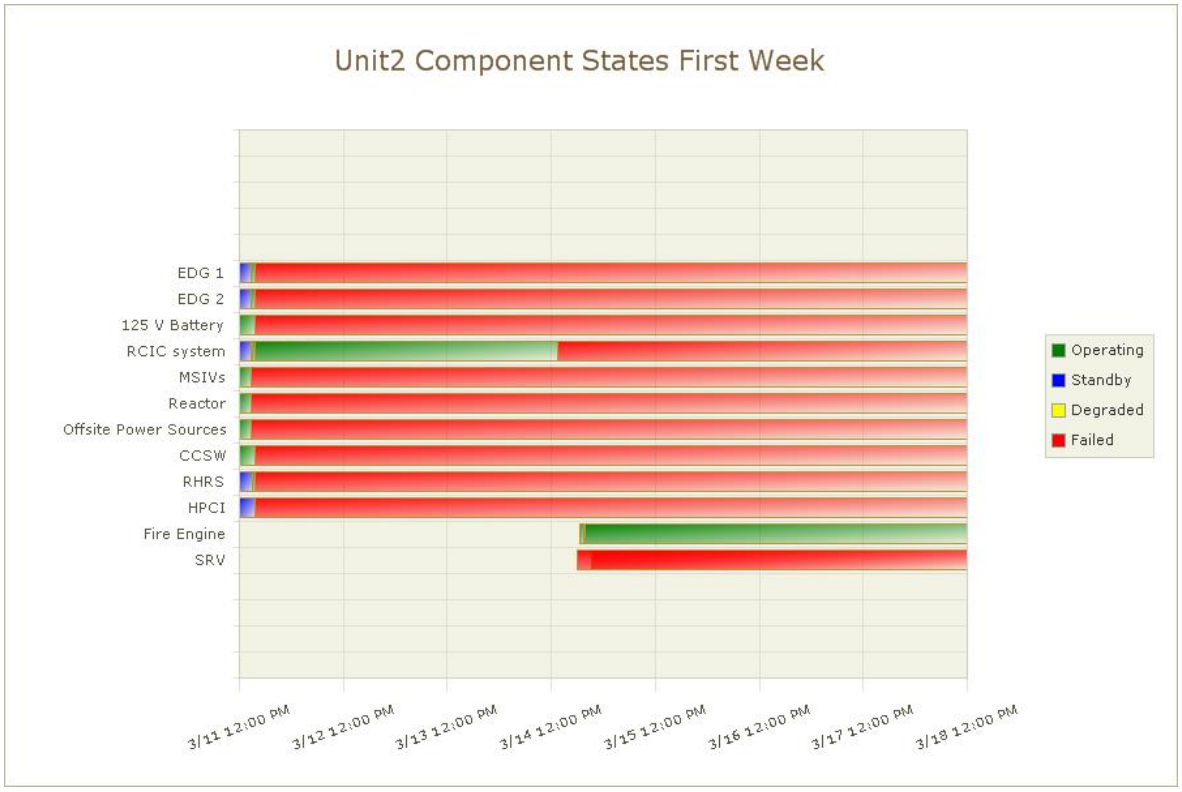
Reactor Core Isolation Cooling (RCI), Turbine driven pump (TDP), RCIC system
3/11/2011 12:00:00 PM to 3/11/2011 2:50:00 PM Standby

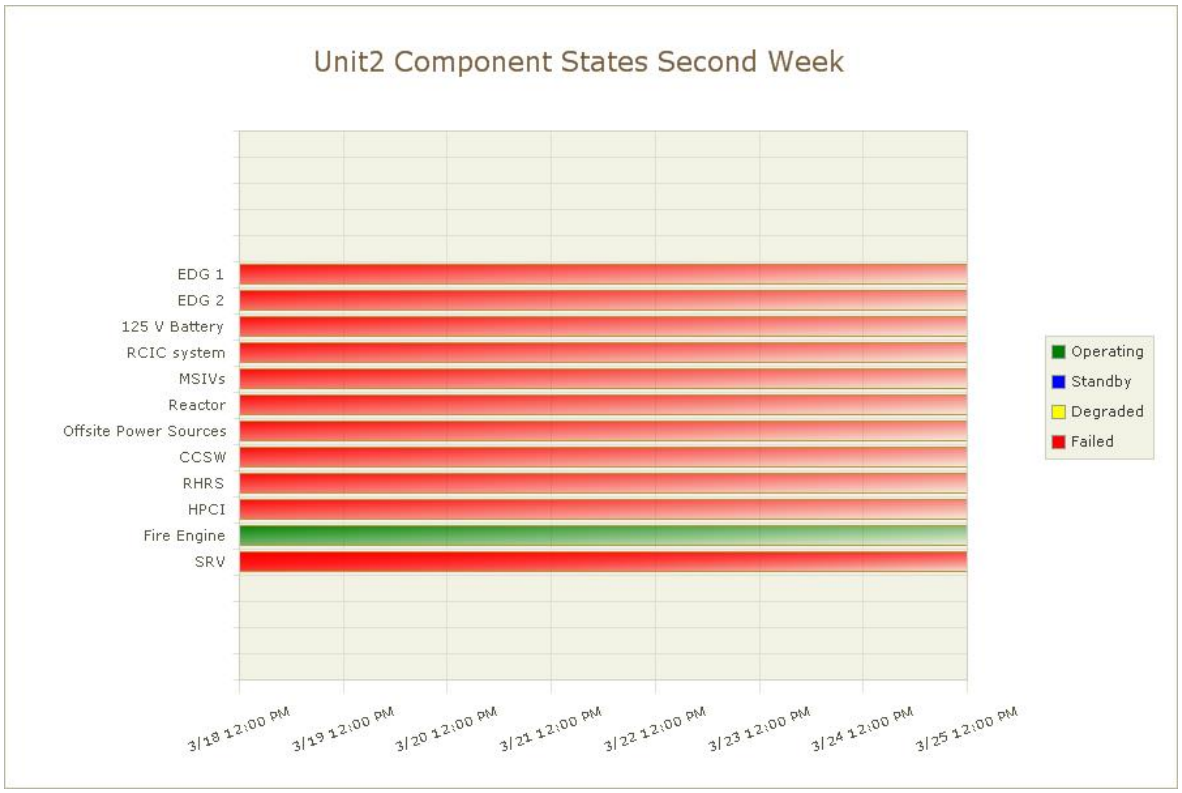
3/11/2011 2:50:00 PM to 3/11/2011 2:51:00 PM Manually Started
3/11/2011 2:51:00 PM to 3/11/2011 3:02:00 PM Automatically Shutdown
3/11/2011 3:02:00 PM to 3/11/2011 3:28:00 PM Manually Started
3/11/2011 3:28:00 PM to 3/11/2011 3:39:00 PM Automatically Shutdown
3/11/2011 3:39:00 PM to 3/14/2011 1:25:11 PM Manually Started
3/14/2011 1:25:11 PM to 8/1/2011 11:59:00 PM Fail to continue running

Reactor Protection (RPS), Actuation Train (ACT), Reactor
3/11/2011 12:00:00 PM to 3/11/2011 2:47:00 PM Operating
3/11/2011 2:47:00 PM to 8/1/2011 11:59:00 PM Reactor Scram

Residual Heat Removal Service Water (RSW), Motor driven pump (MDP), RHRS
3/11/2011 12:00:00 PM to 3/11/2011 3:00:00 PM Standby
3/11/2011 3:00:00 PM to 3/11/2011 3:41:00 PM Manually Started
3/11/2011 3:41:00 PM to 8/1/2011 11:59:00 PM Fail to continue running

Main Steam (MSS), Safety relief valve (SRV), SRV
3/14/2011 6:06:00 PM to 8/1/2011 12:00:00 AM Manually Opened
3/14/2011 9:20:00 PM to 8/1/2011 12:00:00 AM Manually Opened


Unit2 Component States First Week
EDG 1
EDG 2
125 V Battery
RCIC system
MSIVs
Reactor
Offsite Power Sources
CCSW
RHRS
HPCI
Fire Engine
SRV
3/11 12:00 PM
3/12 12:00 PM
3/13 12:00 PM
3/14 12:00 PM
3/15 12:00 PM
3/16 12:00 PM
3/17 12:00 PM
3/18 12:00 PM
Operating
Standby
Degraded
Failed


Unit2 Component States Second Week
EDG 1
EDG 2
125 V Battery
RCIC system
MSIVs
Reactor
Offsite Power Sources
CCSW
RHRS
HPCI
Fire Engine
SRV
3/18 12:00 PM
3/19 12:00 PM
3/20 12:00 PM
3/21 12:00 PM
3/22 12:00 PM
3/23 12:00 PM
3/24 12:00 PM
3/25 12:00 PM
Operating
Standby
Degraded
Failed

Unit3 Component States

DC Power (DCP), Battery (BAT), 125 V Battery
3/11/2011 12:00:00 PM to 3/12/2011 9:30:00 PM Operating
3/12/2011 9:30:00 PM to 8/1/2011 11:59:00 PM Fail to operate

Service Water System (SWS), Motor driven pump (MDP), CCSW
3/11/2011 12:00:00 PM to 3/11/2011 3:41:00 PM Operating
3/11/2011 3:41:00 PM to 8/1/2011 11:59:00 PM Fail to continue running

AC Power System (ACP), Emergency diesel generator (DGN), EDG 1
3/11/2011 12:00:00 PM to 3/11/2011 2:47:00 PM Standby
3/11/2011 2:47:00 PM to 3/11/2011 3:37:00 PM Automatically Started
3/11/2011 3:41:00 PM to 8/1/2011 11:59:00 PM Fail to continue running

AC Power System (ACP), Emergency diesel generator (DGN), EDG 2
3/11/2011 12:00:00 PM to 3/11/2011 2:47:00 PM Standby
3/11/2011 2:47:00 PM to 3/11/2011 3:37:00 PM Automatically Started
3/11/2011 3:41:00 PM to 8/1/2011 11:59:00 PM Fail to continue running

Firewater Injection (FW1), Engine driven pump (EDP), Fire Engine
3/13/2011 9:25:00 AM to 3/13/2011 12:20:00 PM Manually Started
3/13/2011 12:20:00 PM to 3/13/2011 1:12:00 PM Fail to continue running
3/13/2011 1:12:00 PM to 3/14/2011 1:10:00 AM Manually Started
3/14/2011 1:10:00 AM to 3/14/2011 3:20:00 AM Fail to continue running
3/14/2011 3:20:00 AM to 3/14/2011 11:01:00 AM Manually Started
3/14/2011 11:01:00 AM to 3/14/2011 4:30:00 PM Fail to continue running
3/14/2011 4:30:00 PM to 3/31/2011 12:00:00 PM Manually Started

High Pressure Coolant Injection (HCI), Turbine driven pump (TDP), HPCI
3/11/2011 12:00:00 PM to 3/12/2011 12:35:00 PM Standby
3/12/2011 12:35:00 PM to 3/13/2011 2:42:00 AM Automatically Started
3/13/2011 2:42:00 AM to 8/1/2011 11:59:00 PM Fail to continue running

Power Conversion (PCS), Main steam isolation valve (MSV), MSIVs
3/11/2011 12:00:00 PM to 3/11/2011 2:48:00 PM Normally Open; Not failed
3/11/2011 2:48:00 PM to 8/1/2011 3:41:00 PM Normally open; fail in closed position

Offsite Electrical Power (OEP), System level event (SYS), Offsite Power Sources

3/11/2011 12:00:00 PM to 3/11/2011 2:47:00 PM Operating
3/11/2011 2:47:00 PM to 8/1/2011 11:59:00 PM No power-loss of power

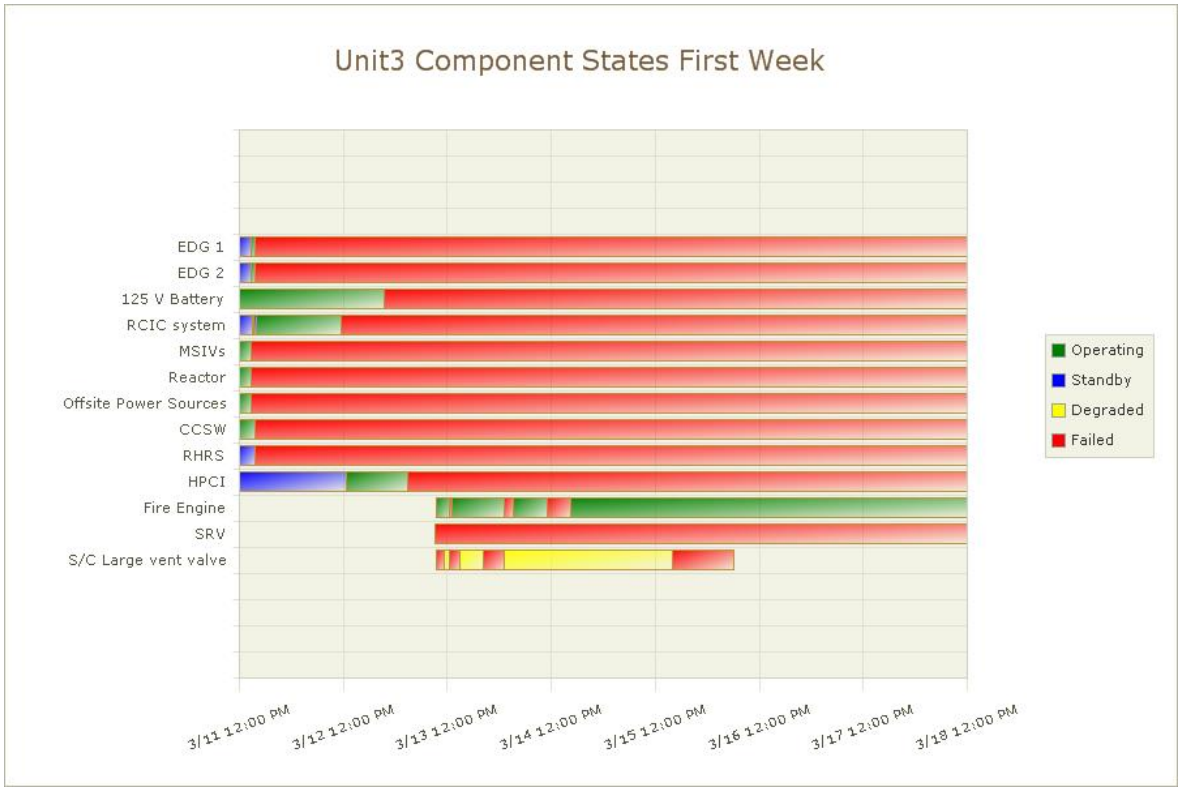
Reactor Core Isolation Cooling (RCI), Turbine driven pump (TDP), RCIC system
3/11/2011 12:00:00 PM to 3/11/2011 3:05:00 PM Standby
3/11/2011 3:05:00 PM to 3/11/2011 3:25:00 PM Manually Started
3/11/2011 3:25:00 PM to 3/11/2011 4:03:00 PM Automatically Shutdown
3/11/2011 4:03:00 PM to 3/12/2011 11:36:00 AM Manually Started
3/12/2011 11:36:00 AM to 8/1/2011 12:00:00 AM Fail to continue running

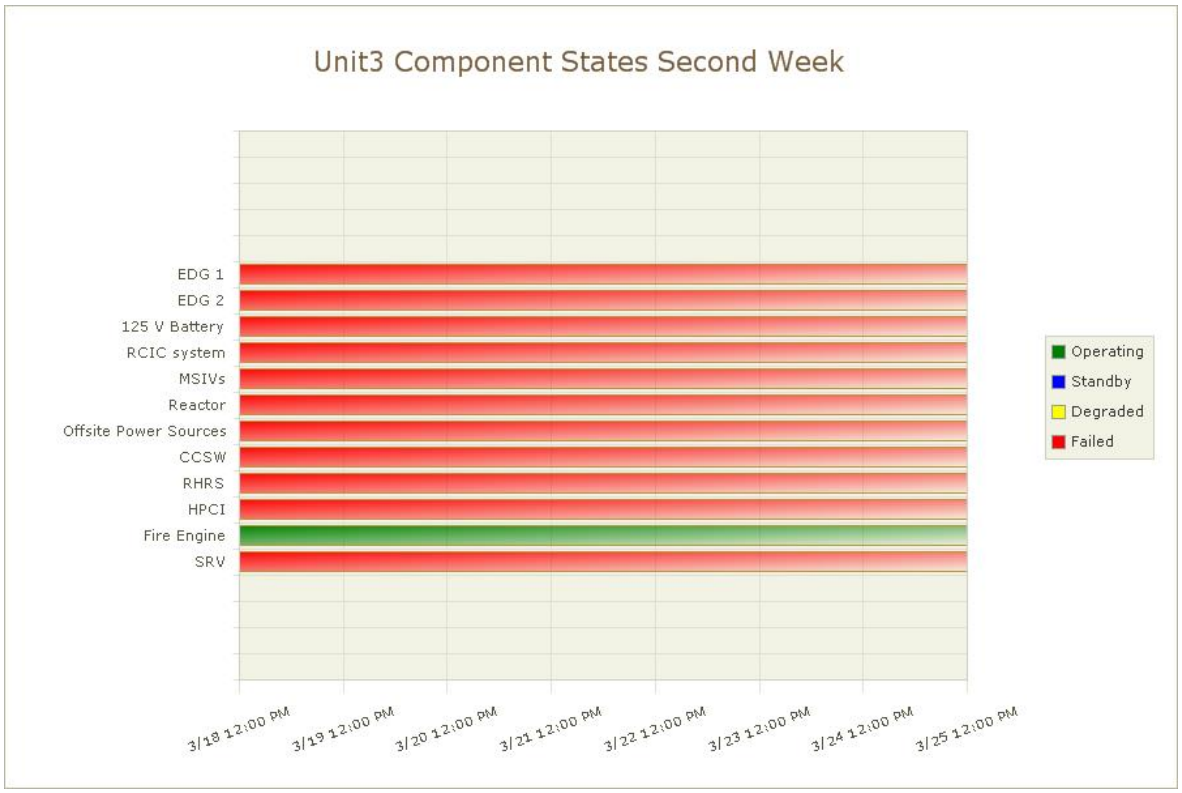
Reactor Protection (RPS), Actuation Train (ACT), Reactor
3/11/2011 12:00:00 PM to 3/11/2011 2:47:00 PM Operating
3/11/2011 2:47:00 PM to 8/1/2011 11:59:00 PM Reactor Scram

Residual Heat Removal Service Water (RSW), Motor driven pump (MDP), RHRS
3/11/2011 12:00:00 PM to 3/11/2011 3:41:00 PM Standby
3/11/2011 3:41:00 PM to 8/1/2011 11:59:00 PM Fail to start

Containment Vent (CVS), Air operated valve (AOV), S/C Large vent valve
3/13/2011 9:20:00 AM to 3/13/2011 11:17:00 AM Manually Opened
3/13/2011 11:17:00 AM to 3/13/2011 12:30:00 PM Normally closed; fail in the closed position
3/13/2011 12:30:00 PM to 3/13/2011 3:00:00 PM Manually Opened
3/13/2011 3:00:00 PM to 3/13/2011 8:10:00 PM Normally closed; fail in the closed position
3/13/2011 8:10:00 PM to 3/14/2011 1:00:00 AM Manually Opened
3/14/2011 1:00:00 AM to 3/15/2011 4:05:00 PM Normally closed; fail in the closed position
3/15/2011 4:05:00 PM to 3/16/2011 6:15:00 AM Manually Opened

Main Steam (MSS), Safety relief valve (SRV), SRV
3/13/2011 9:08:00 AM to 5/1/2011 12:00:00 PM Manually Opened

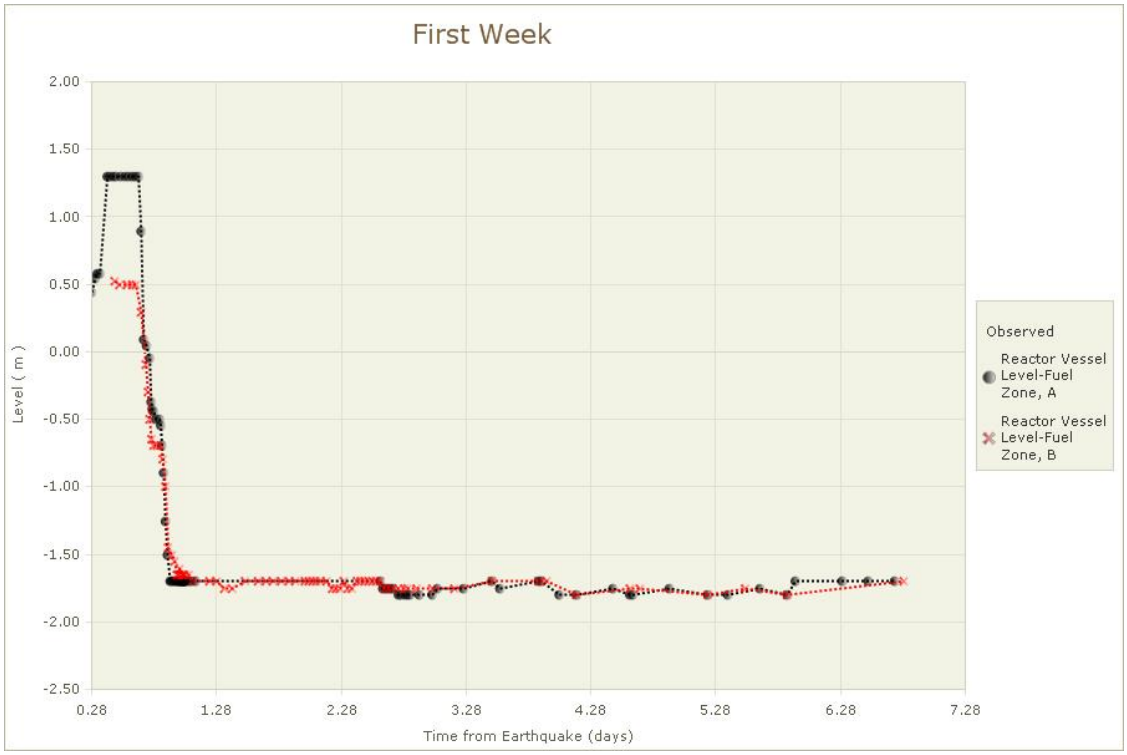

Unit3 Component States First Week
EDG 1
EDG 2
125 V Battery
RCIC system
MSIVs
Reactor
Offsite Power Sources
CCSW
RHRS
HPCI
Fire Engine
SRV
S/C Large vent valve
3/11 12:00 PM
3/12 12:00 PM
3/13 12:00 PM
3/14 12:00 PM
3/15 12:00 PM
3/16 12:00 PM
3/17 12:00 PM
3/18 12:00 PM
Operating
Standby
Degraded
Failed

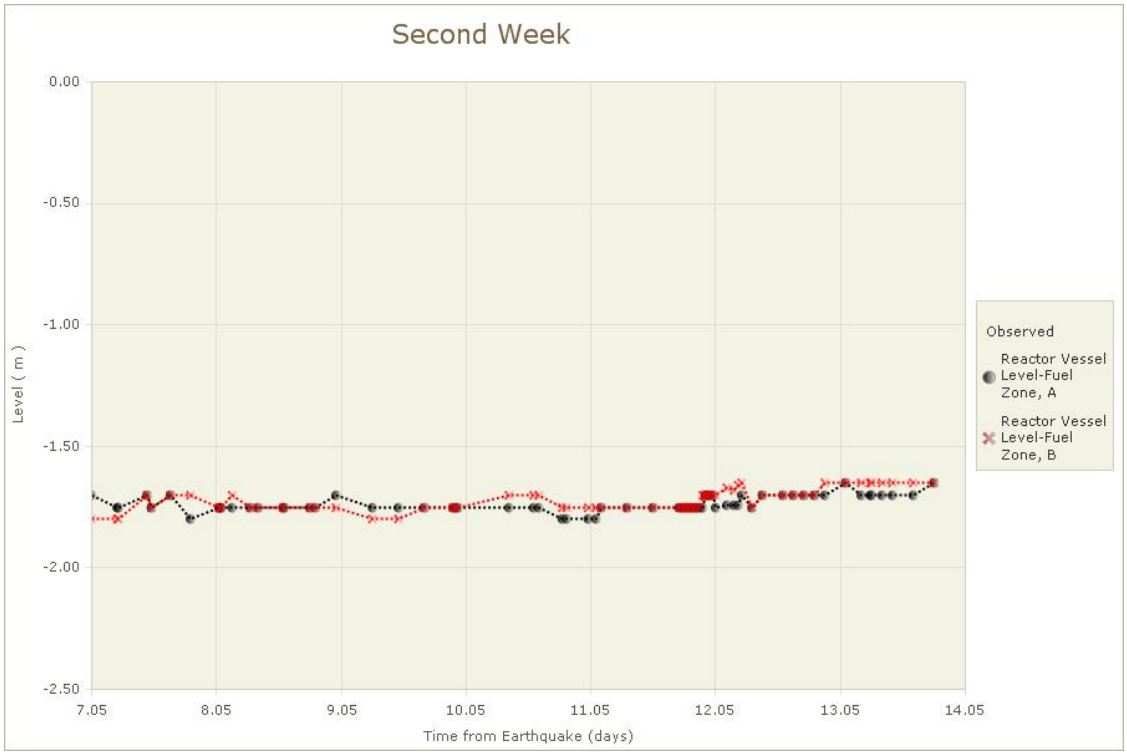

Unit3 Component States Second Week
EDG 1
EDG 2
125 V Battery
RCIC system
MSIVs
Reactor
Offsite Power Sources
CCSW
RHRS
HPCI
Fire Engine
SRV
3/18 12:00 PM
3/19 12:00 PM
3/20 12:00 PM
3/21 12:00 PM
3/22 12:00 PM
3/23 12:00 PM
3/24 12:00 PM
3/25 12:00 PM
Operating
Standby
Degraded
Failed

Parameter Data Artifacts

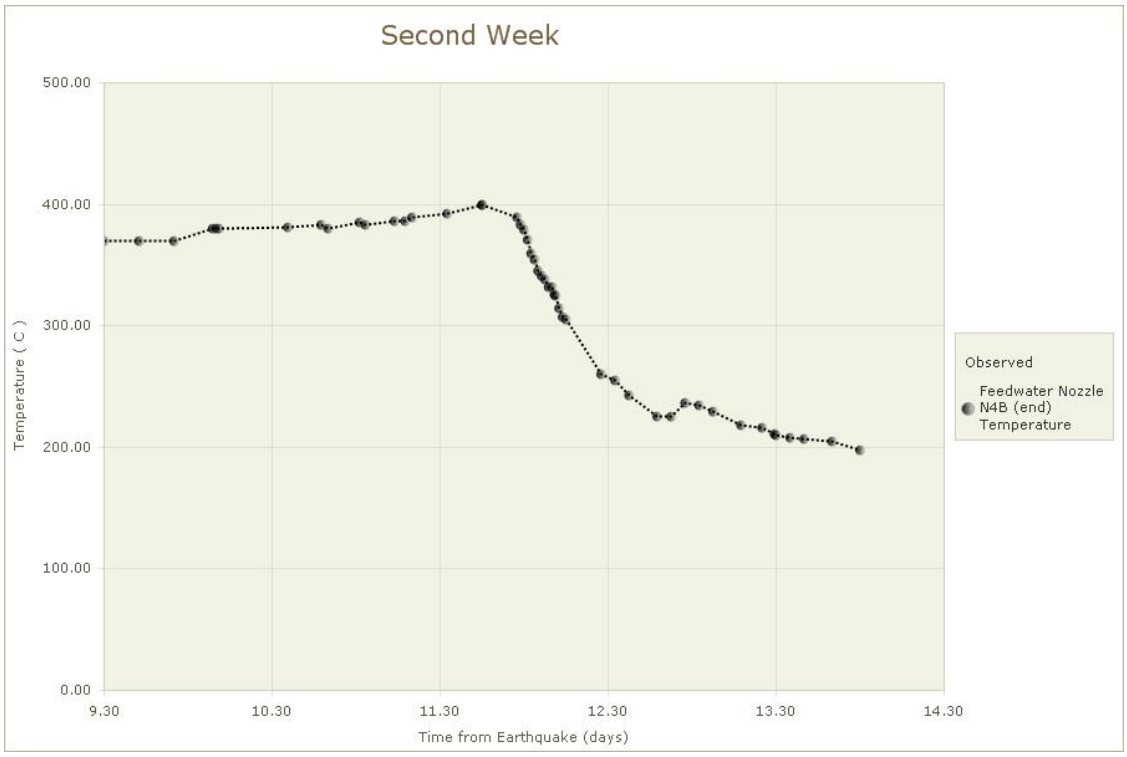
Unit 1 Parameters-Observed

Unit1 Reactor Vessel Level (Observed)

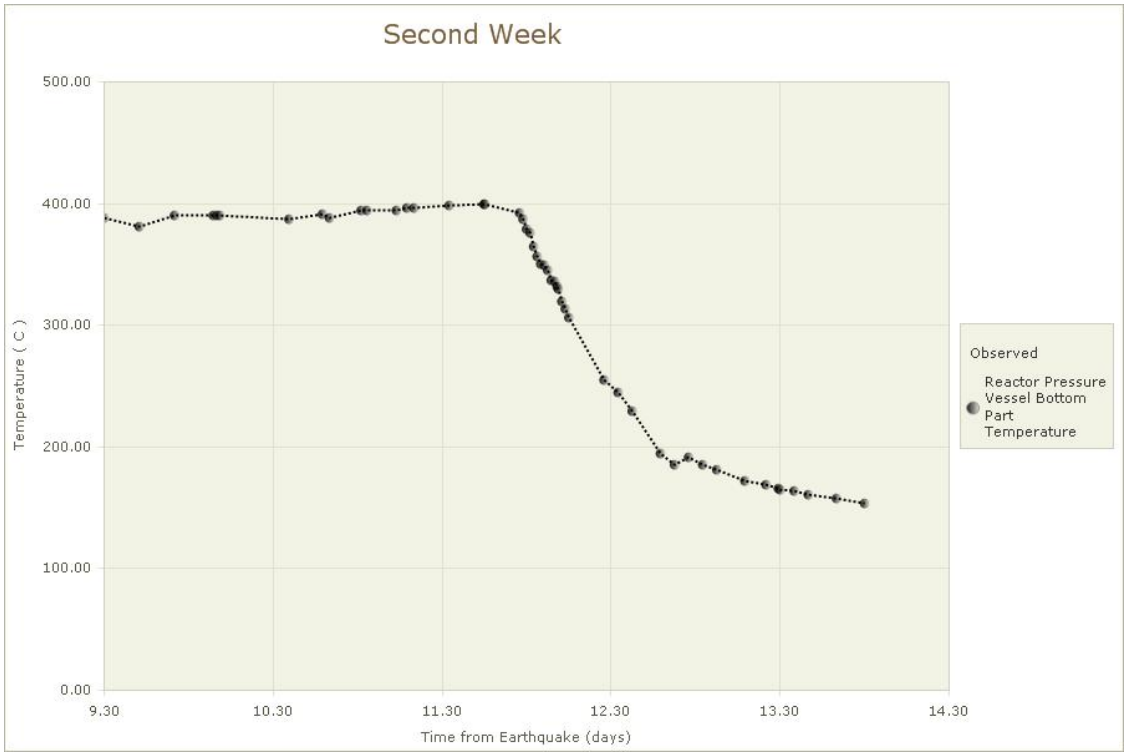




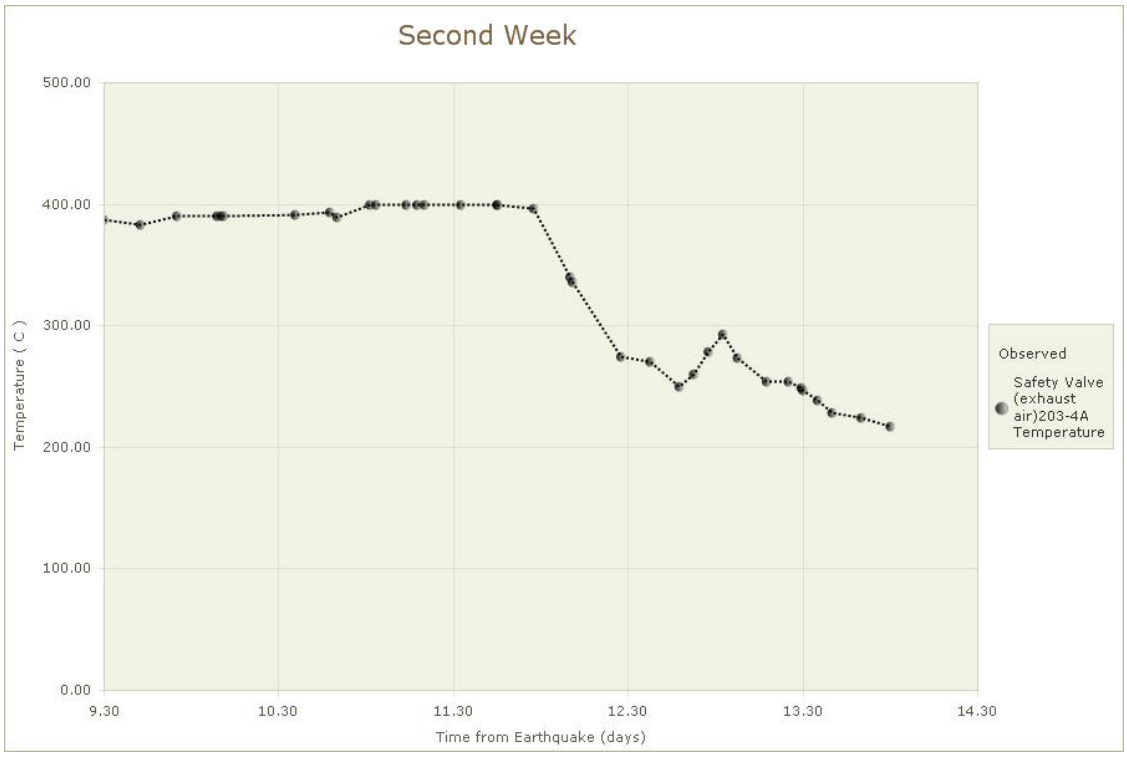
Unit1 Feedwater Nozzle N4B (end) Temperature (Observed)



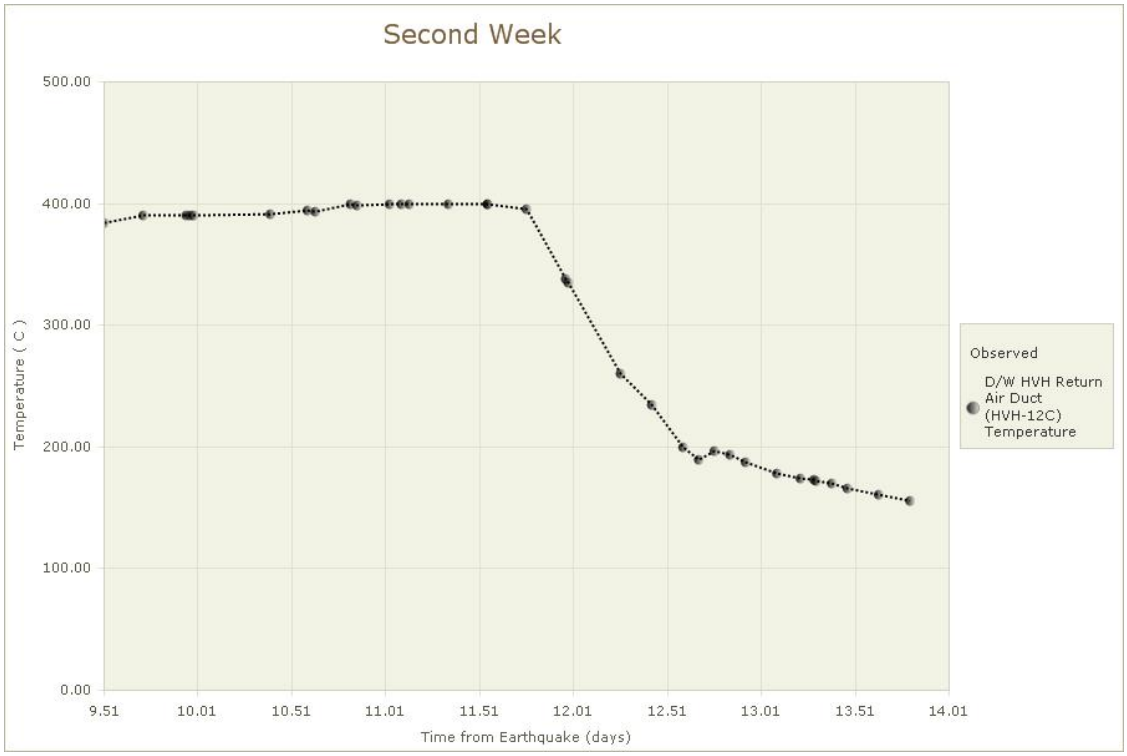
Unit1 Reactor Pressure Vessel Bottom Part Temperature (Observed)



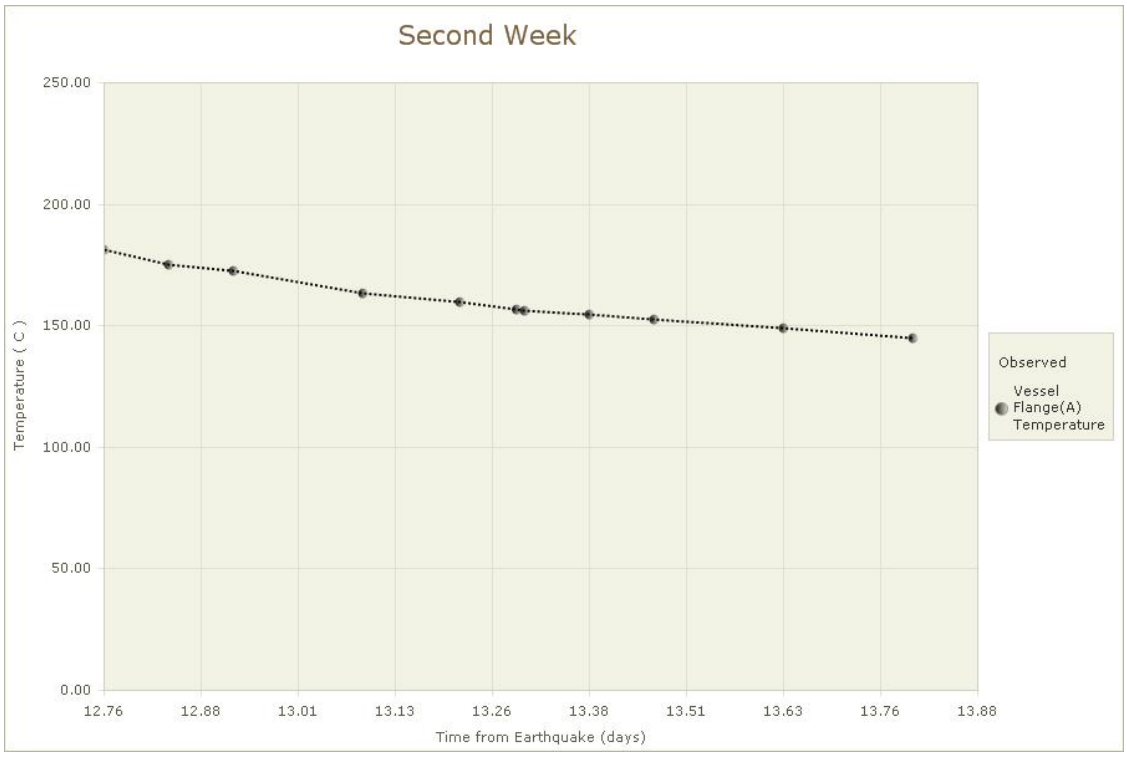
Unit1 Safety Valve (exhaust air)203-4A Temperature (Observed)



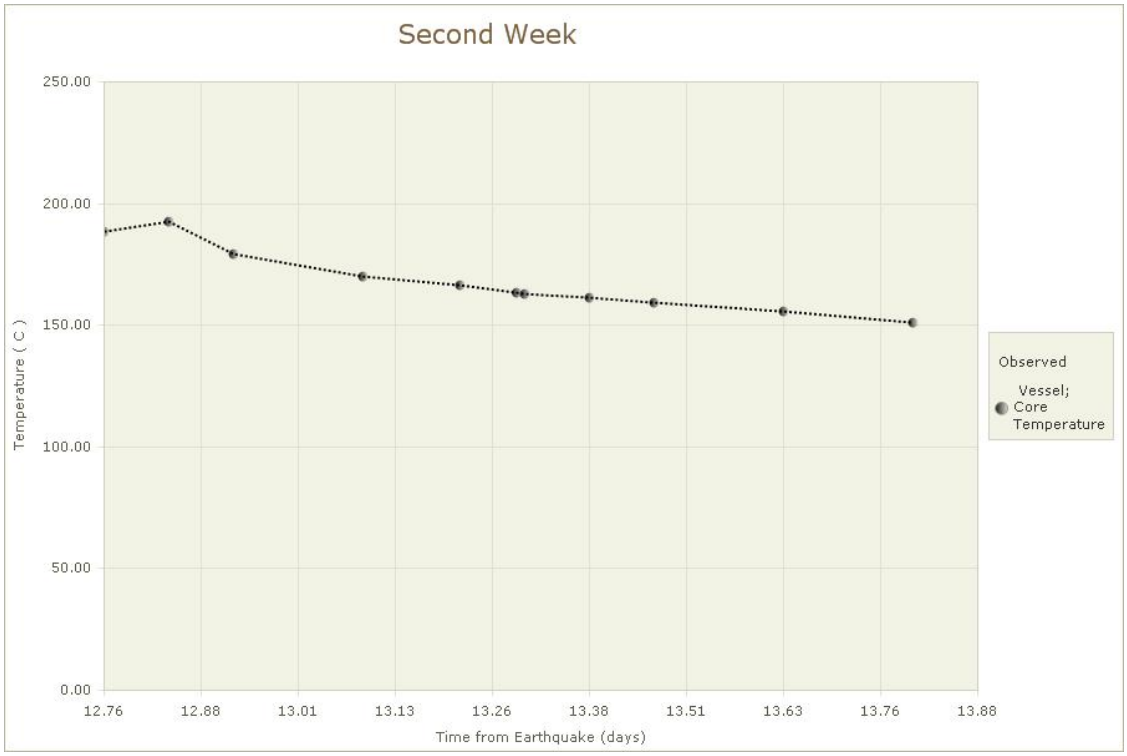
Unit1 D/W HVH Return Air Duct (HVH-12C) Temperature (Observed)



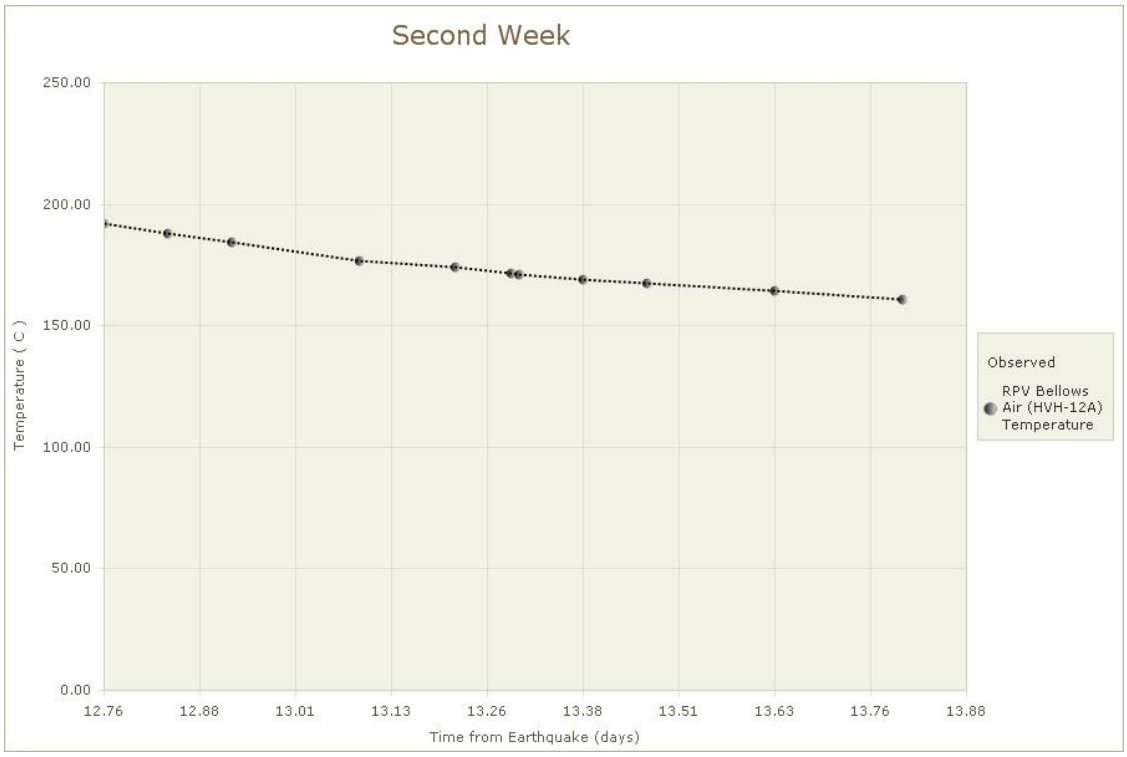
Unit1 Vessel Flange(A) Temperature (Observed)



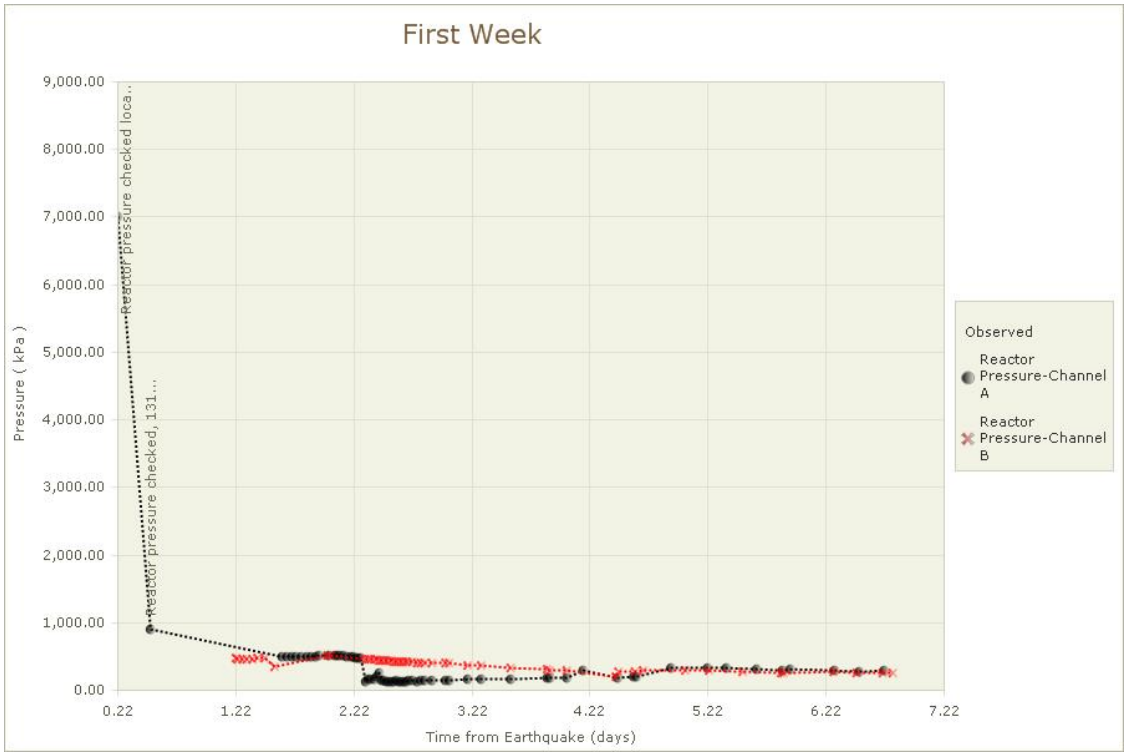
Unit1 Vessel; Core Temperature (Observed)

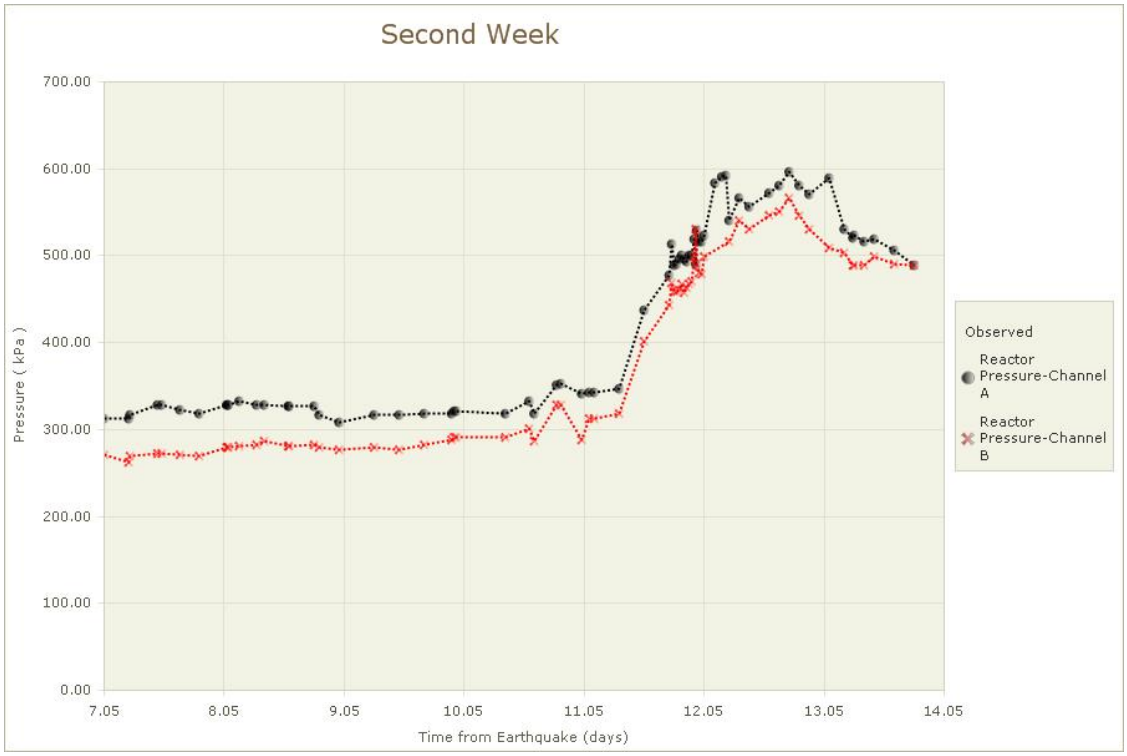


Unit1 RPV Bellows Air (HVH-12A) Temperature (Observed)

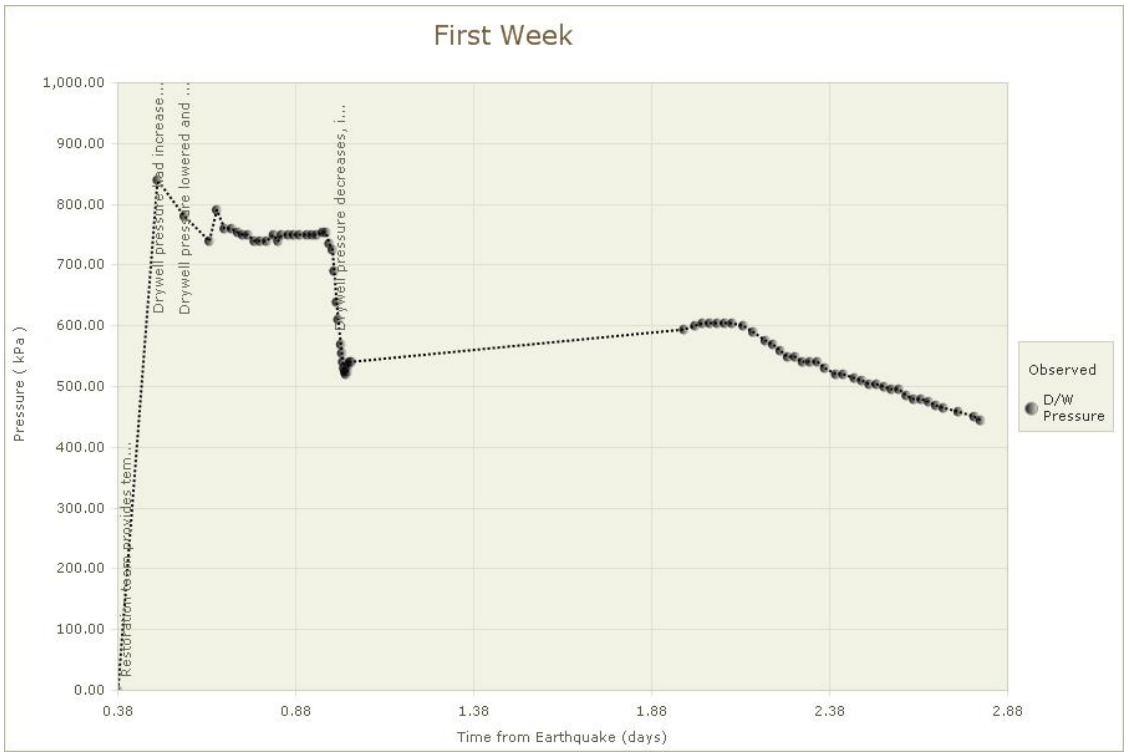


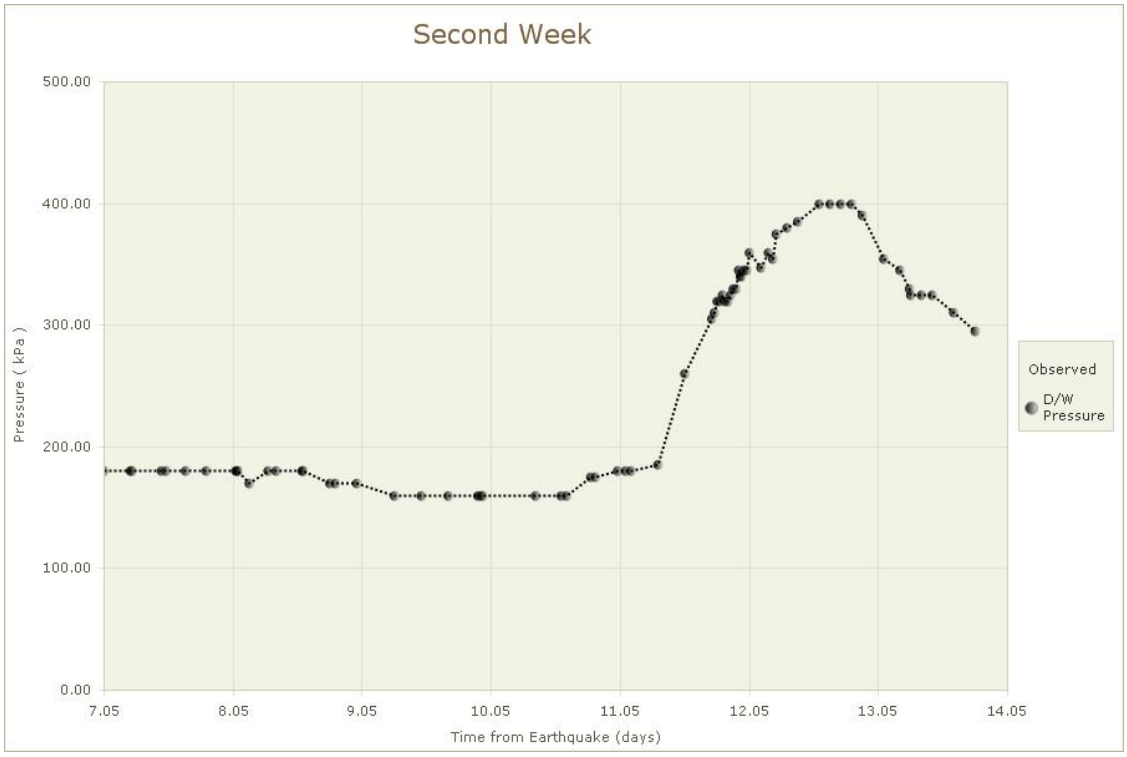
Unit1 Reactor Pressure (Observed)



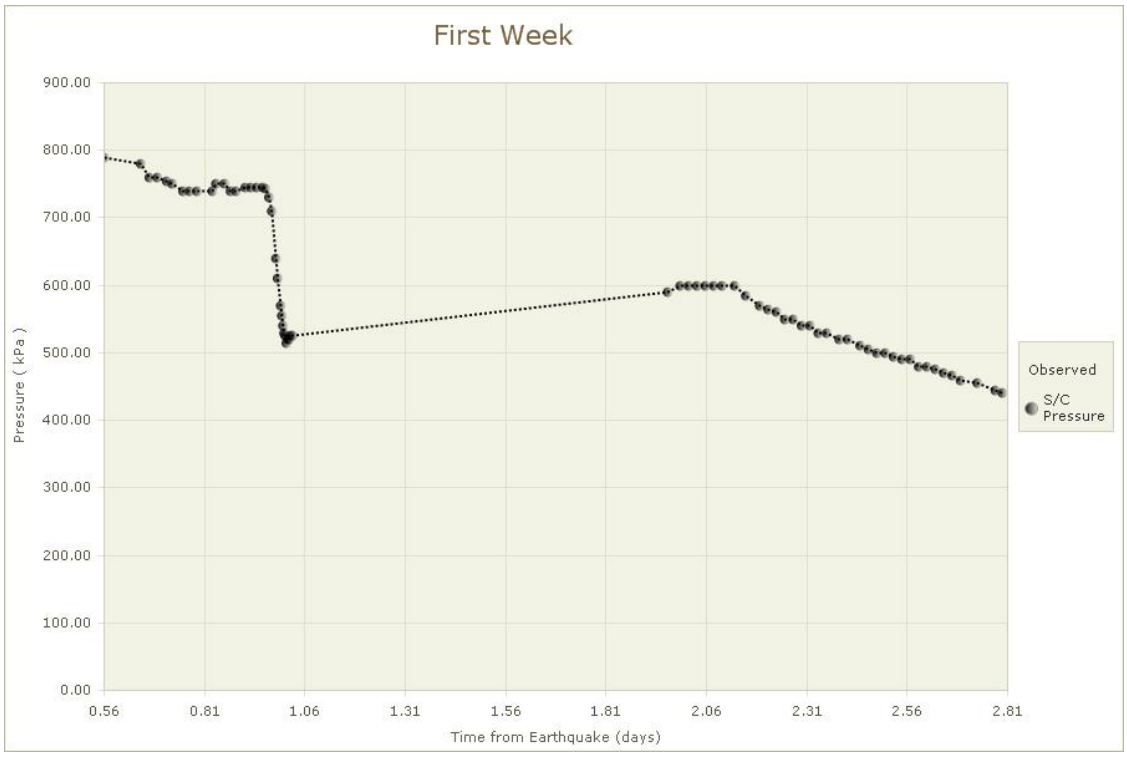


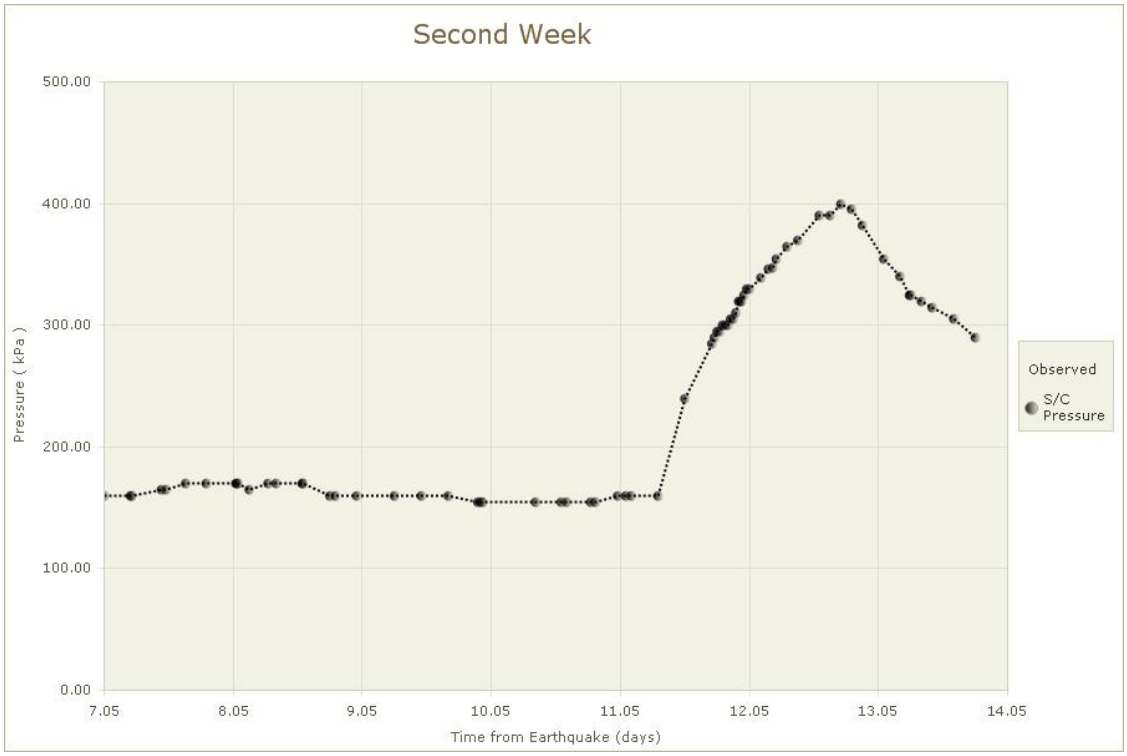
Unit1 D/W Pressure (Observed)





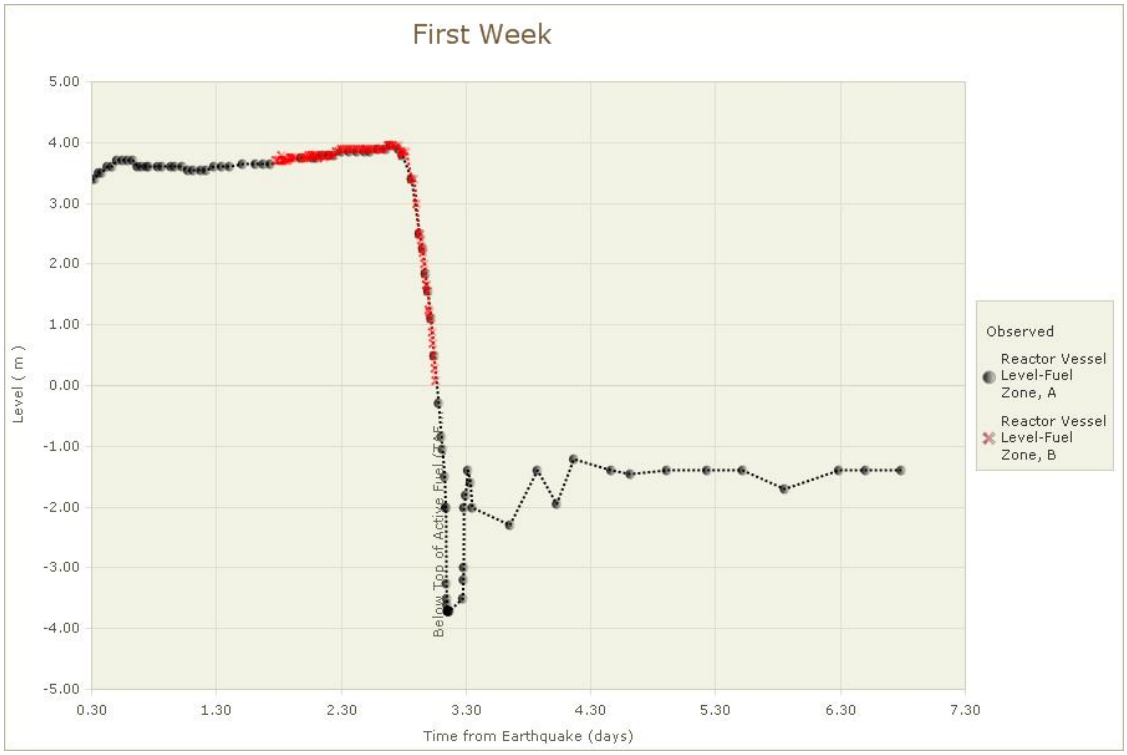
Unit1 S/C Pressure (Observed)

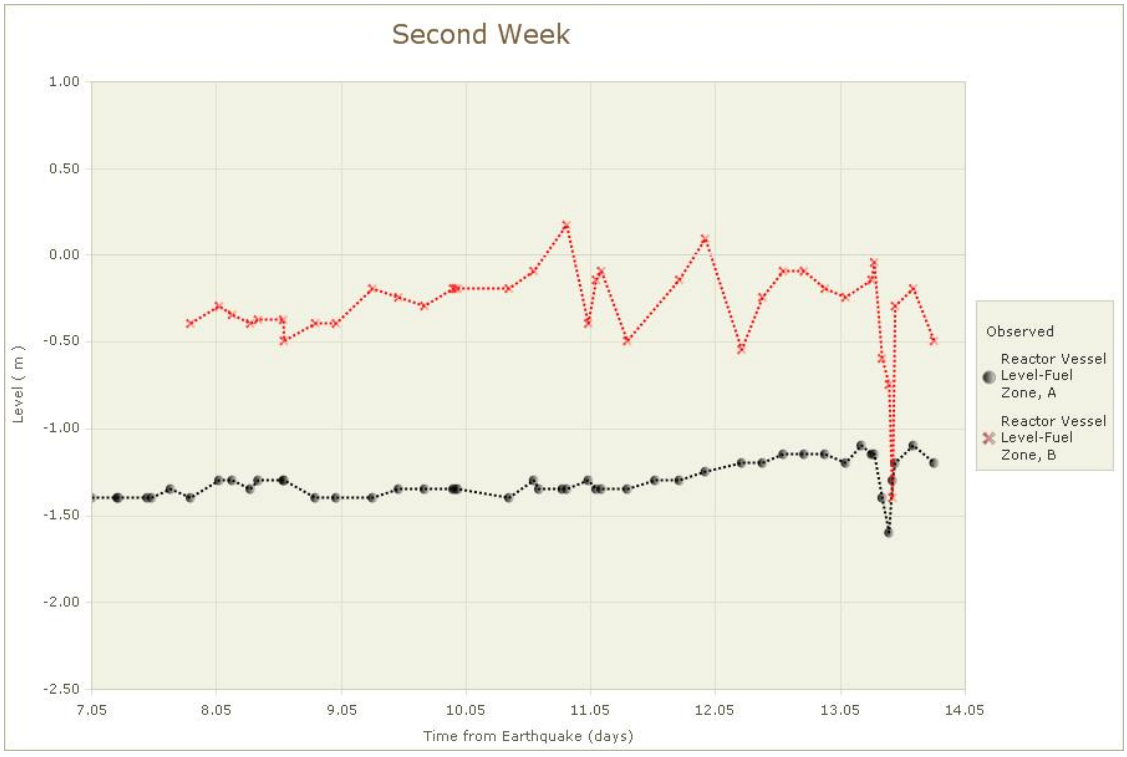



Second Week
500.00
400.00
300.00
200.00
100.00
0.00
Pressure (kPa)
7.05
8.05
9.05
10.05
11.05
12.05
13.05
14.05
Time from Earthquake (days)
Observed
S/C Pressure

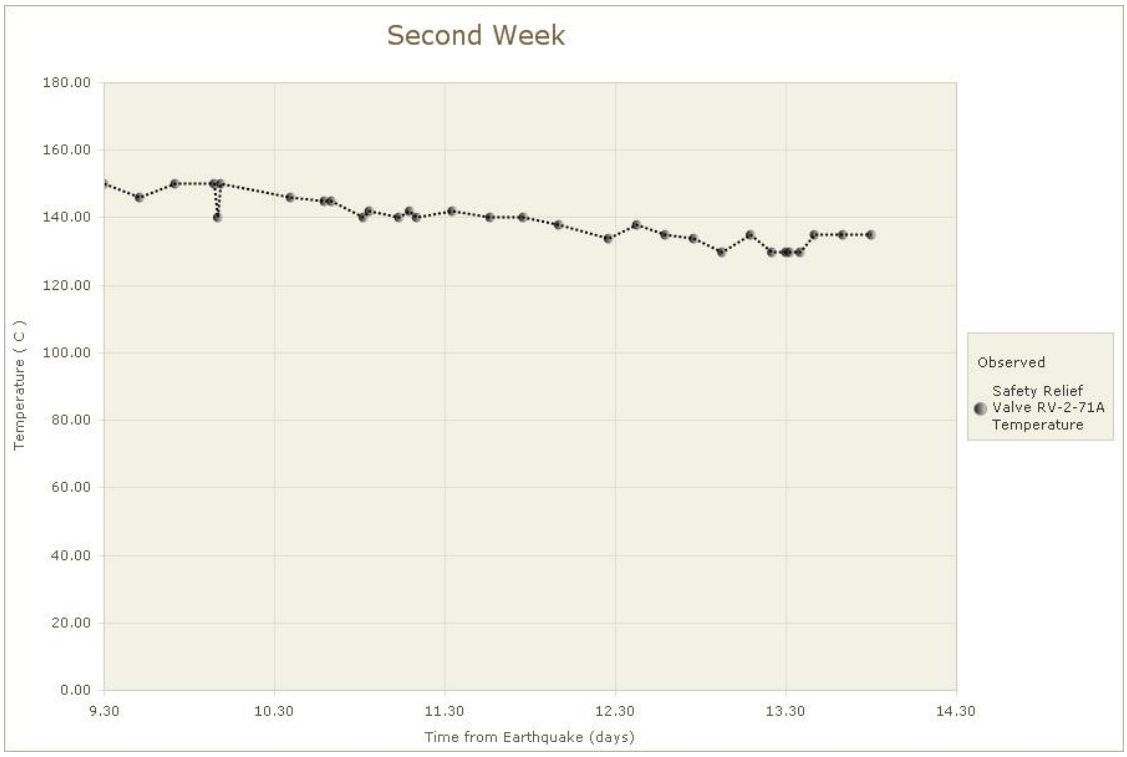
Unit 2 Parameters-Observed

Unit2 Reactor Vessel Level (Observed)

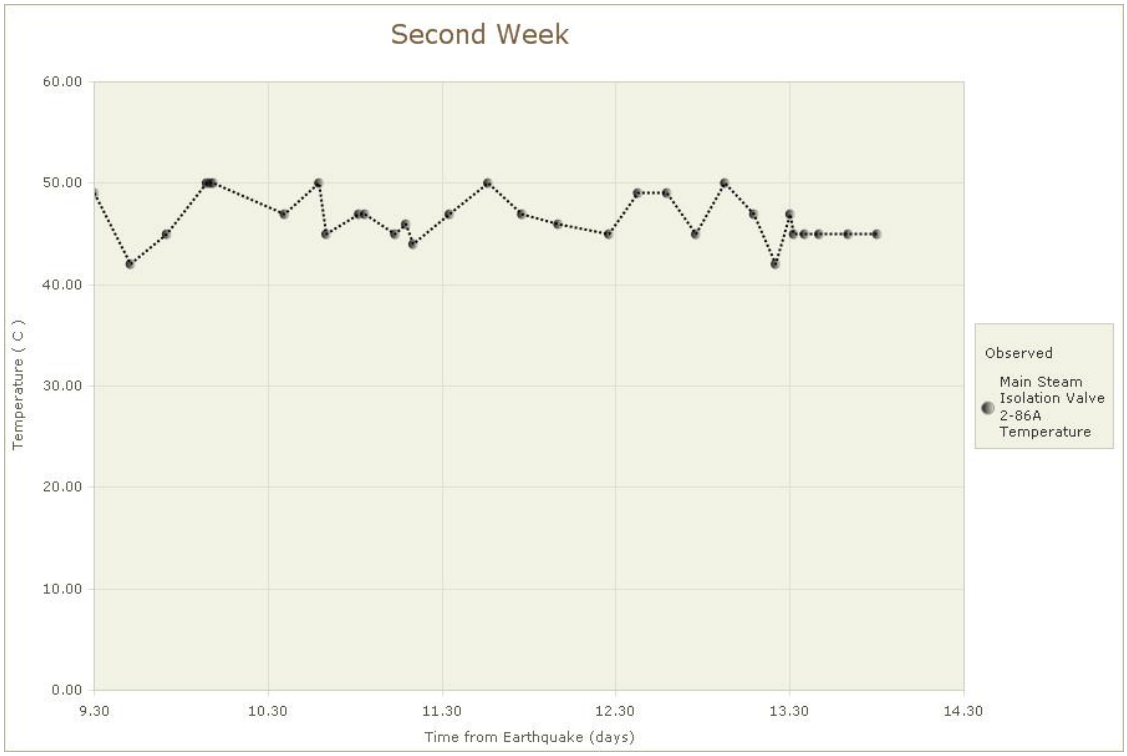




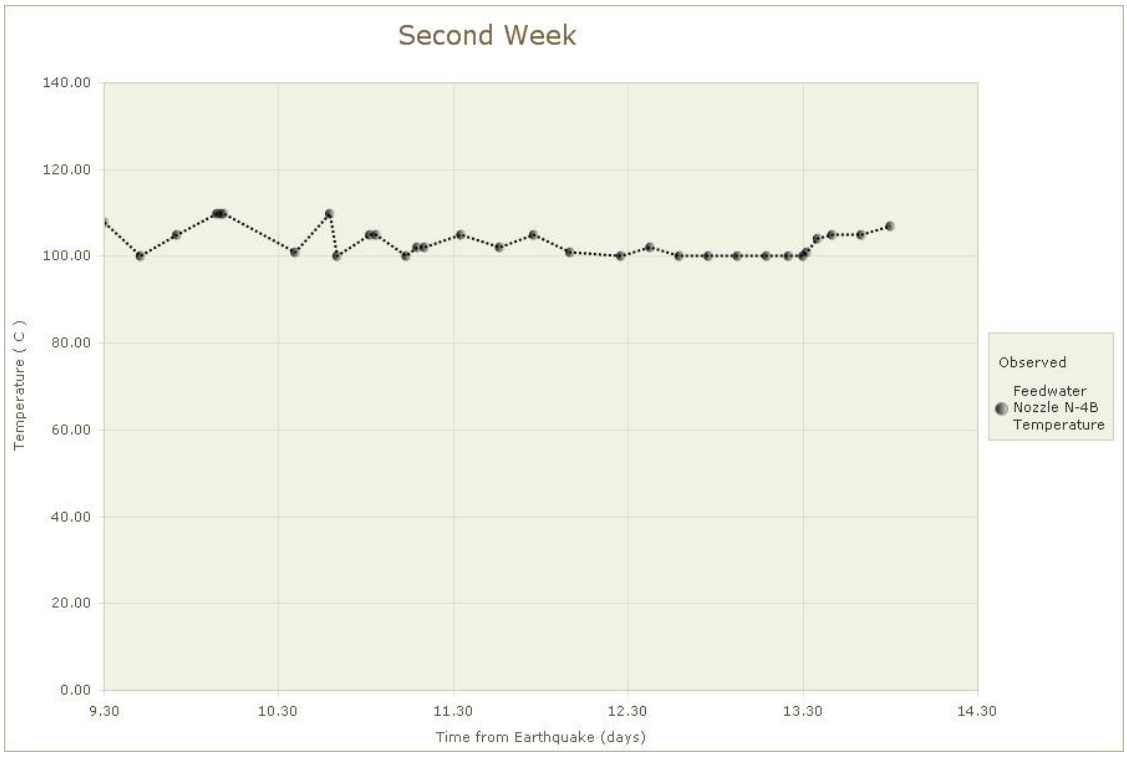
Unit2 Safety Relief Valve RV-2-71A Temperature (Observed)



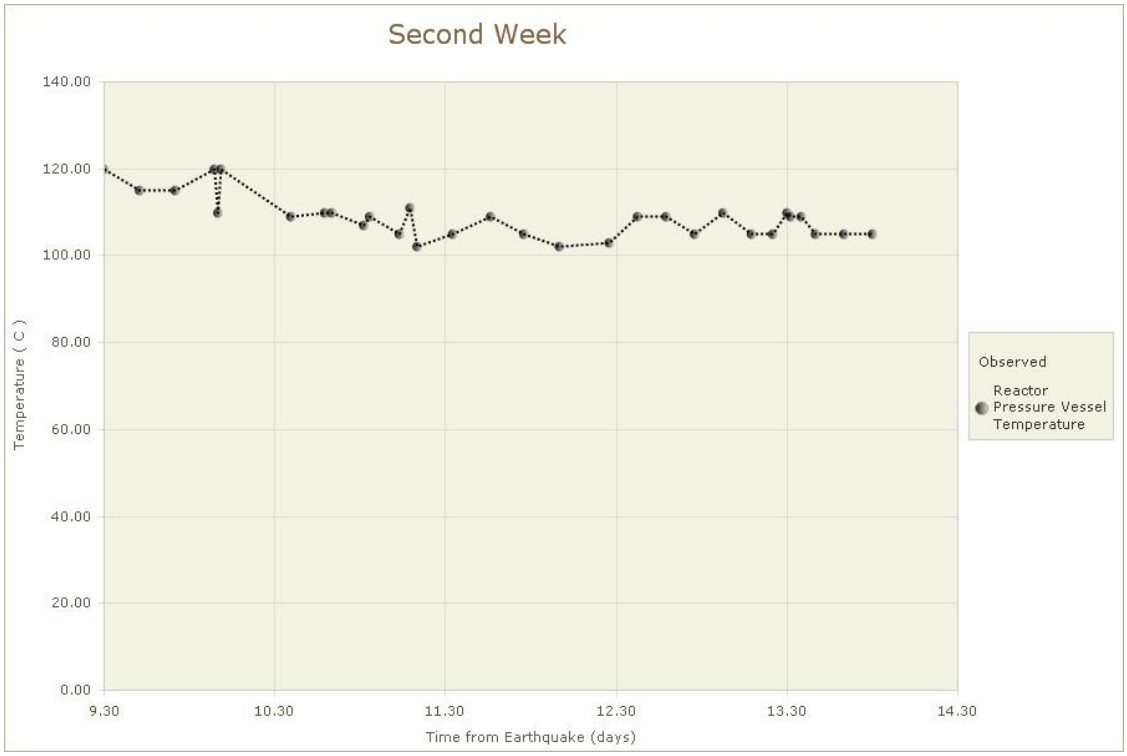
Unit2 Main Steam Isolation Valve 2-86A Temperature (Observed)



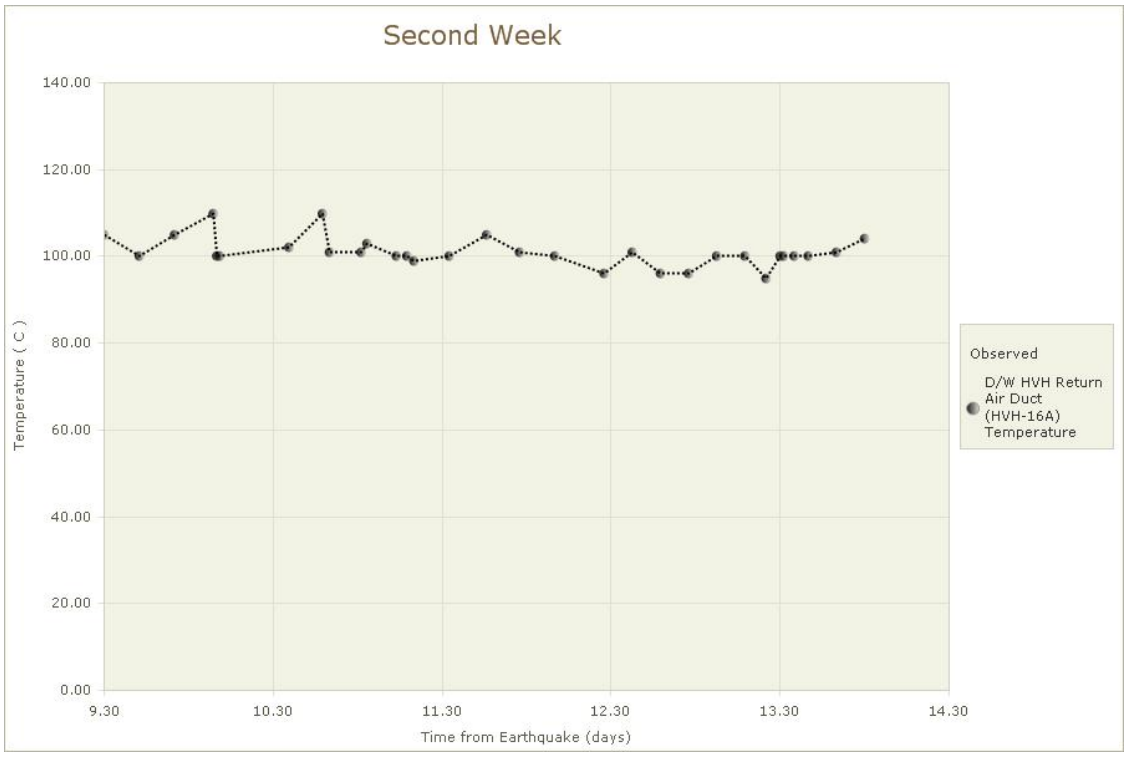
Unit2 Feedwater Nozzle N-4B Temperature (Observed)



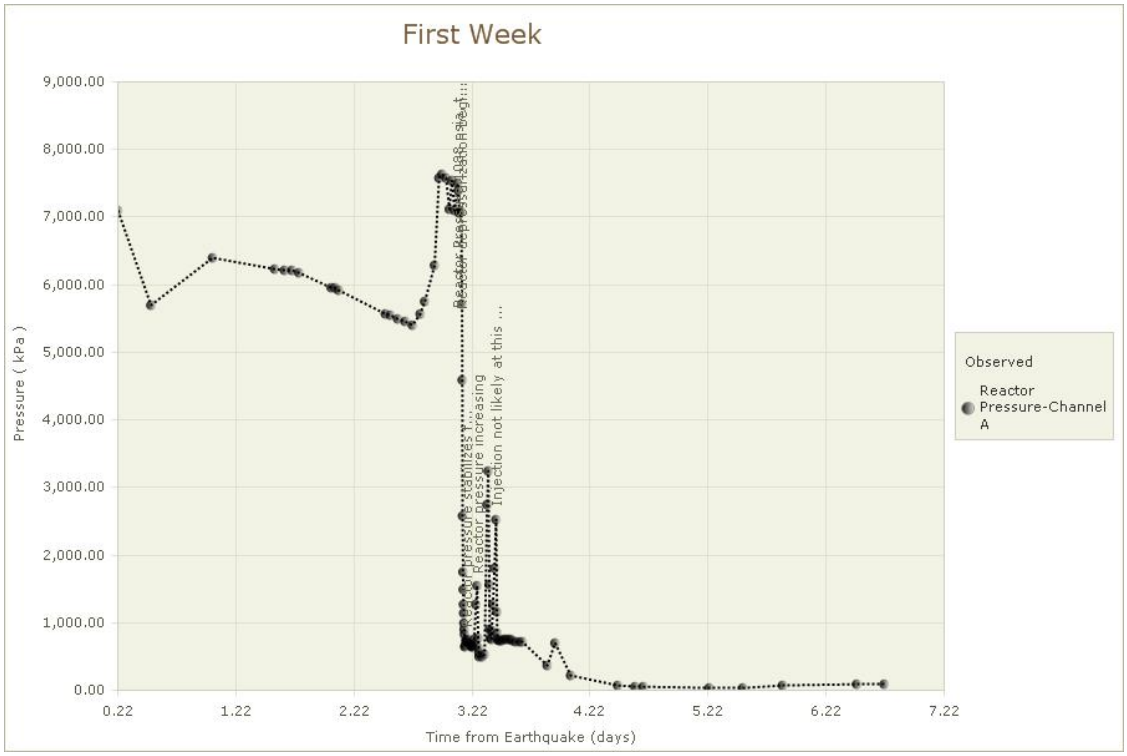
Unit2 Reactor Pressure Vessel Temperature (Observed)

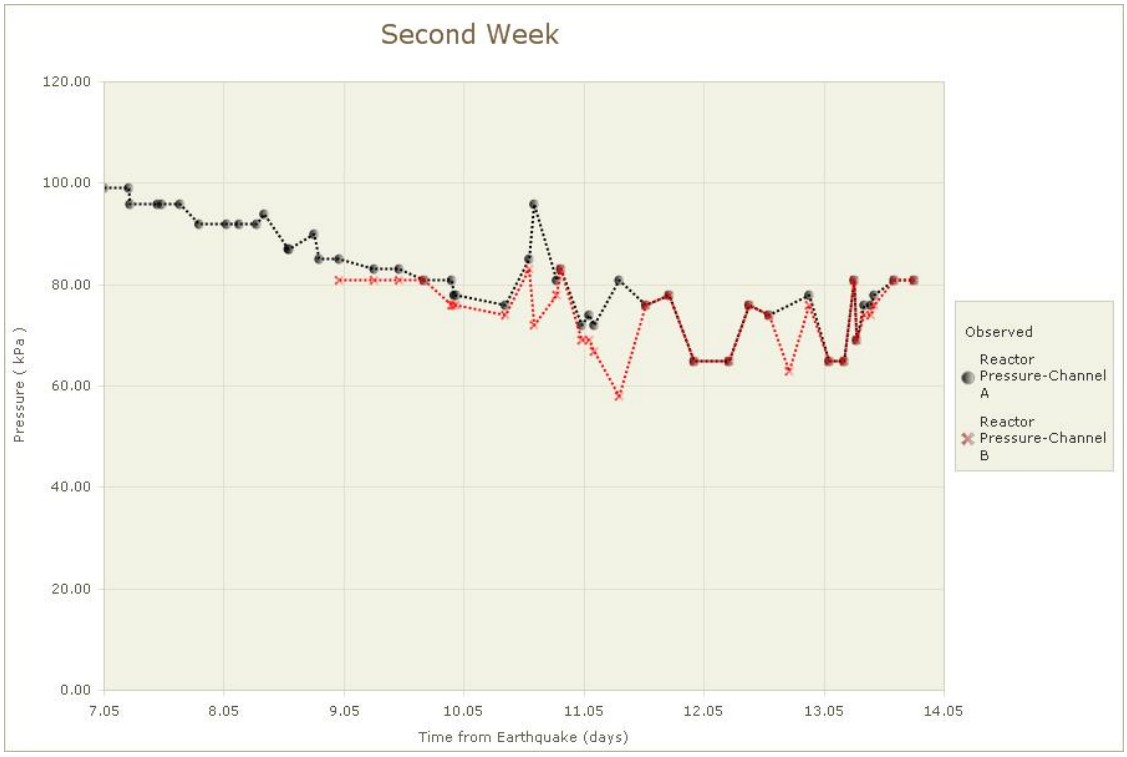


Unit2 D/W HVH Return Air Duct (HVH-16A) Temperature (Observed)

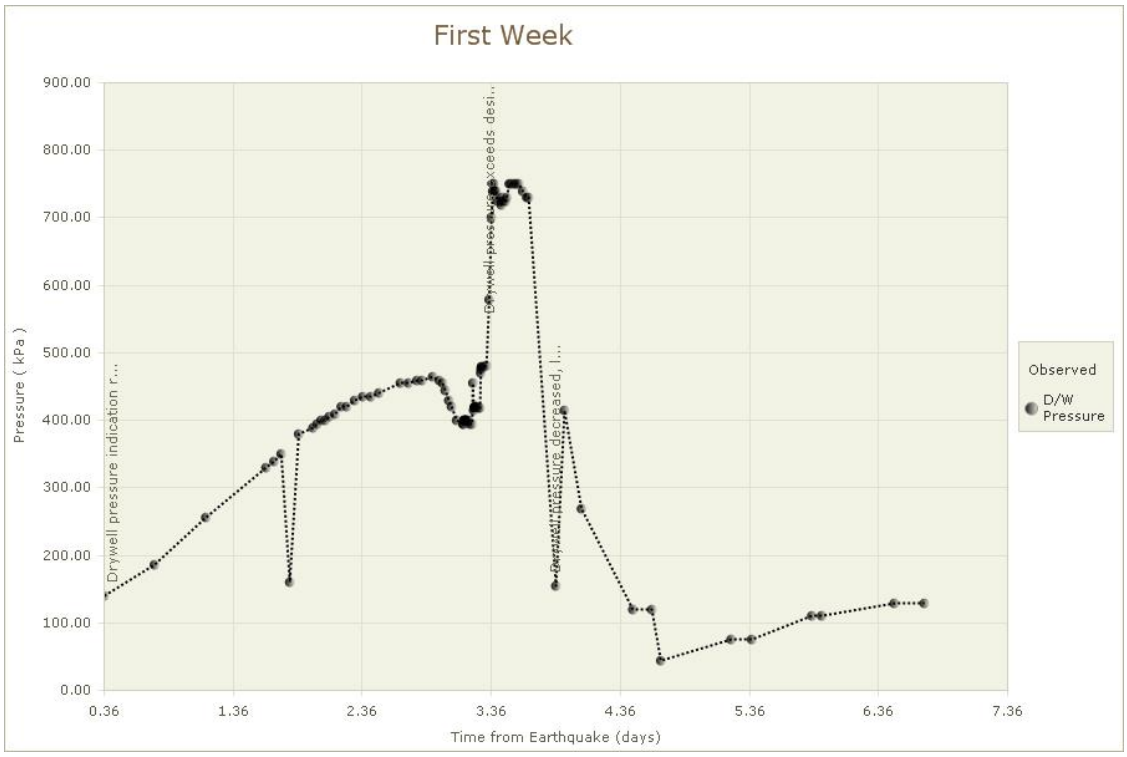


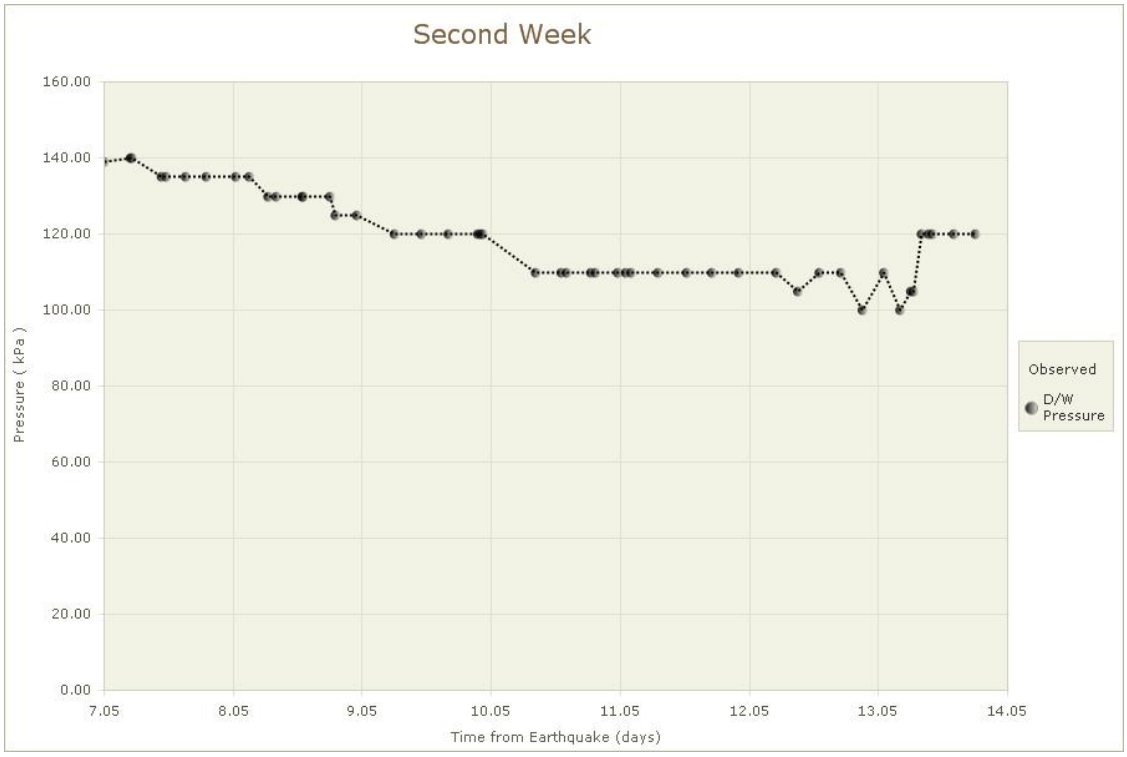
Unit2 Reactor Pressure (Observed)



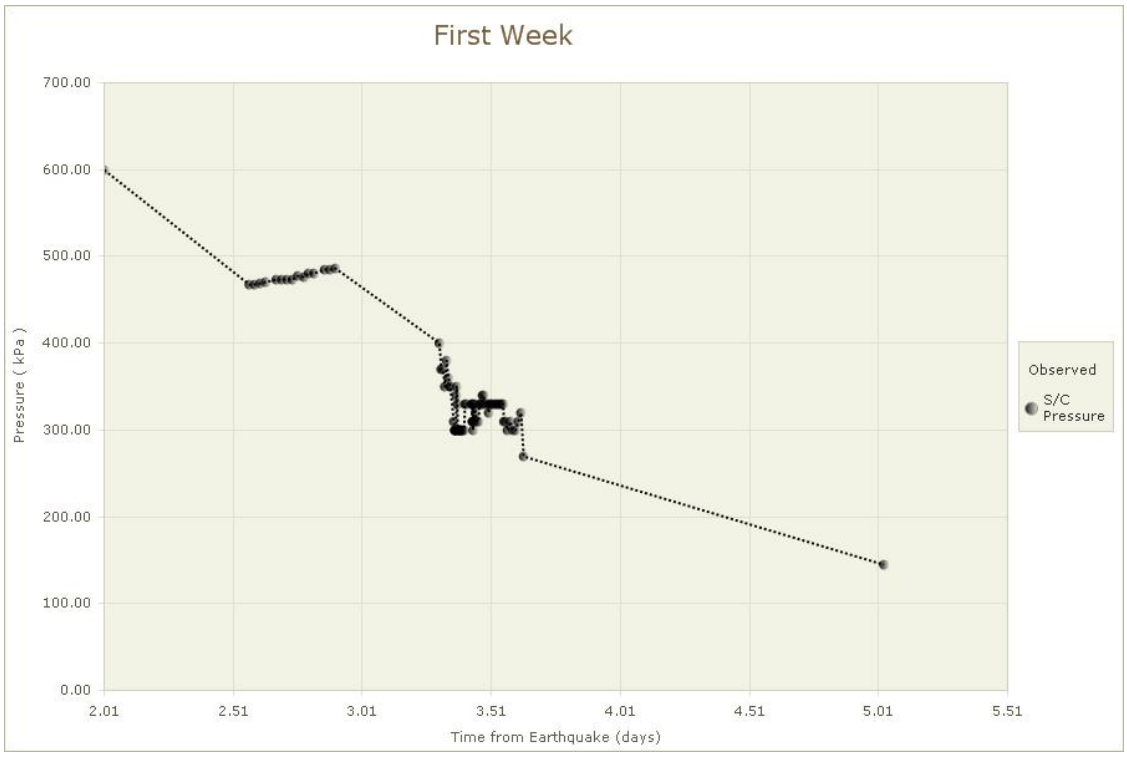


Unit2 D/W Pressure (Observed)



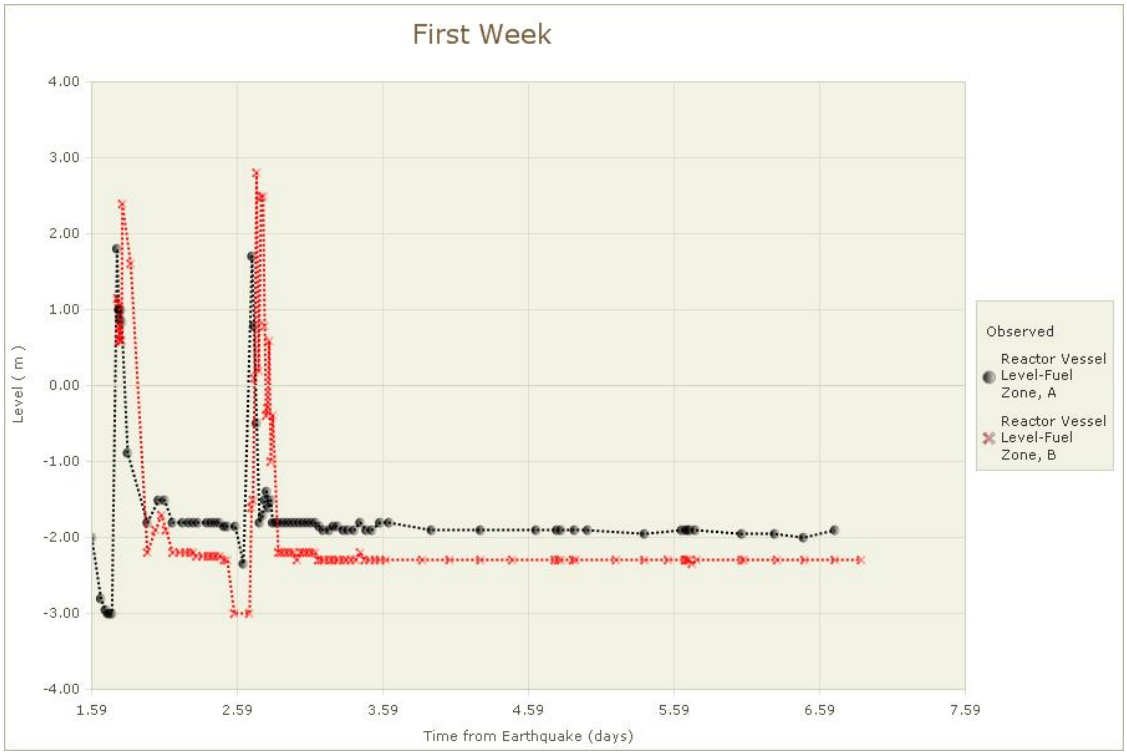


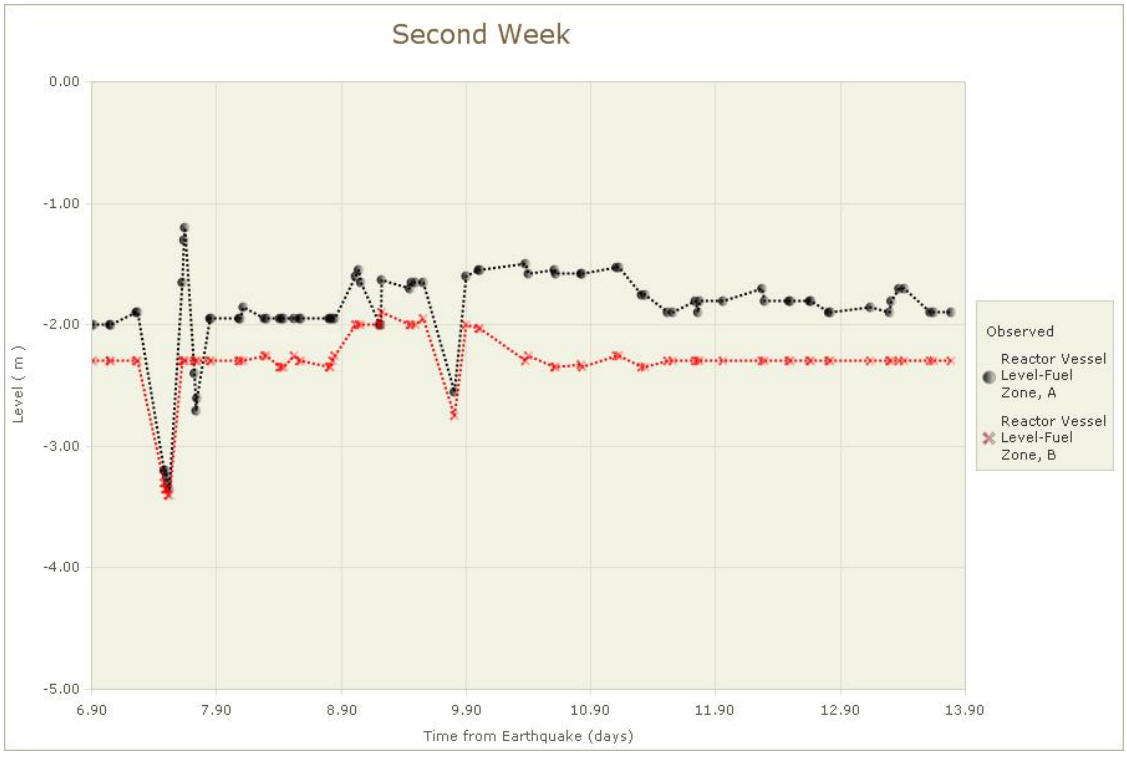
Unit2 S/C Pressure (Observed)



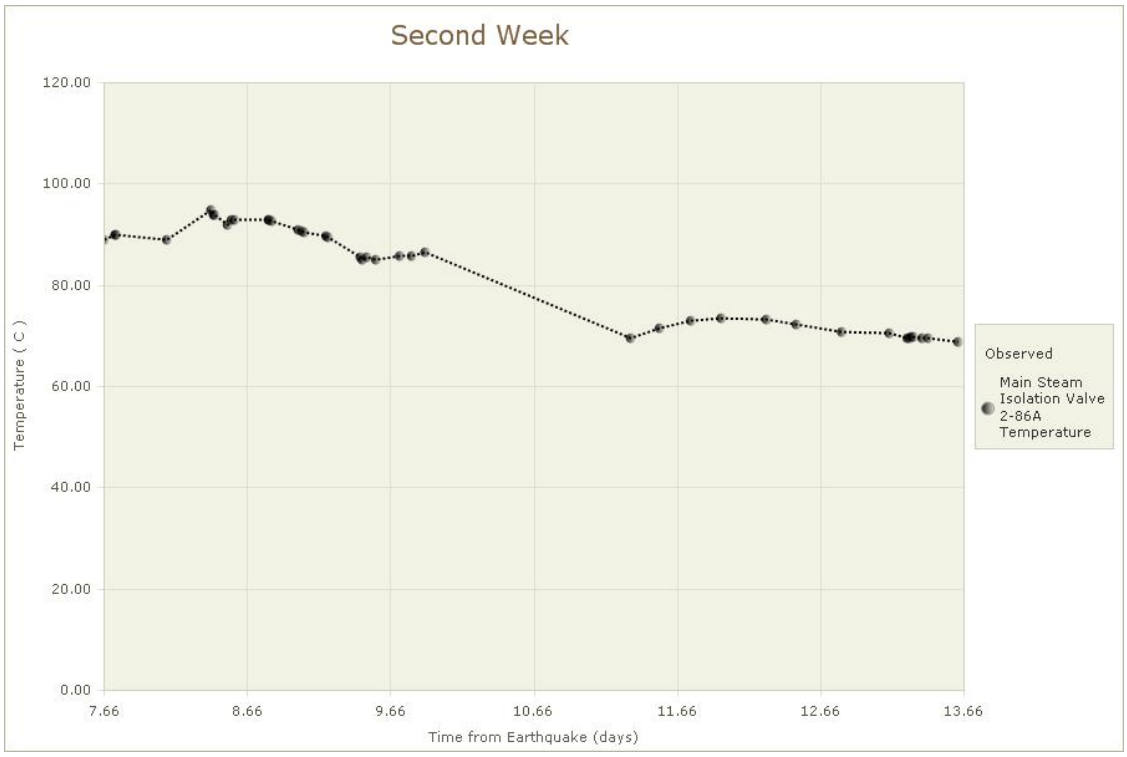
Unit 3 Parameters-Observed

Unit3 Reactor Vessel Level (Observed)

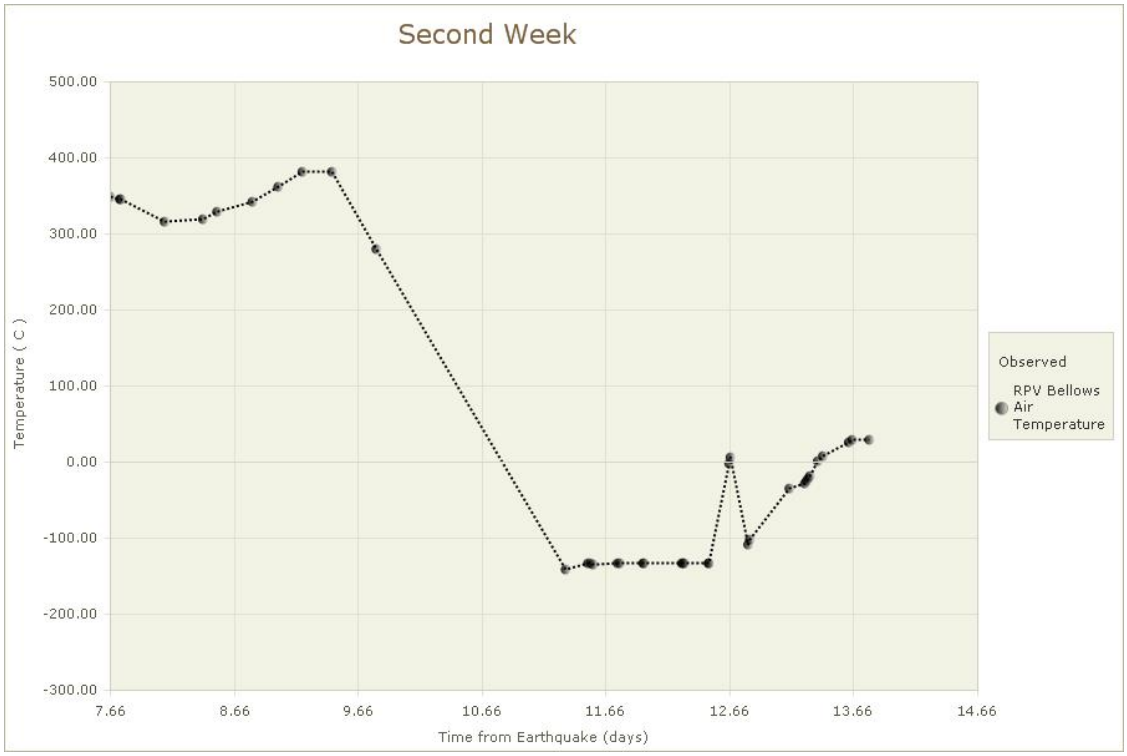




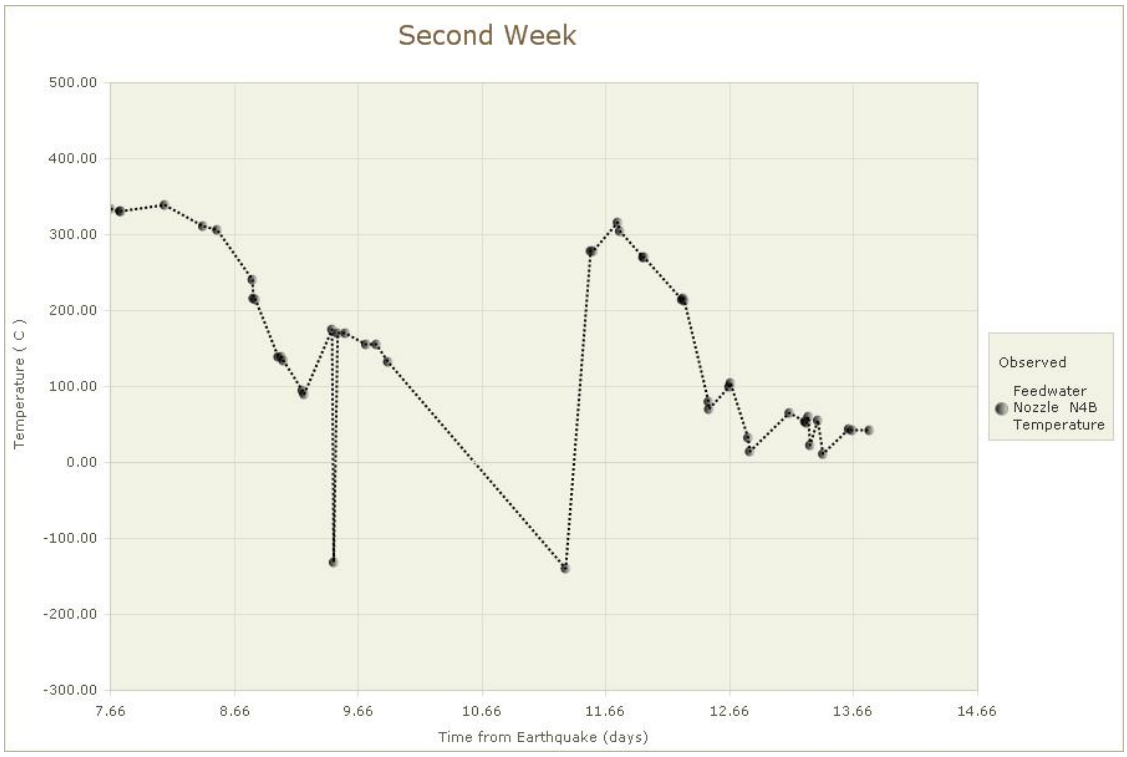
Unit3 Main Steam Isolation Valve 2-86A Temperature (Observed)



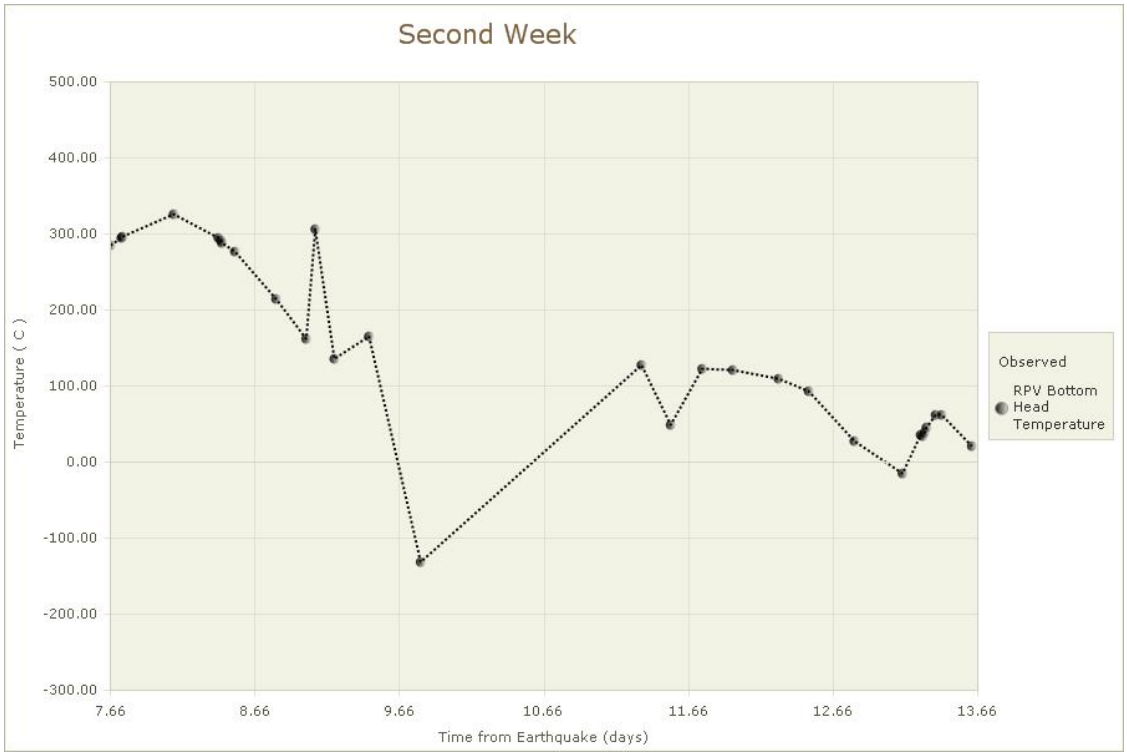
Unit3 RPV Bellows Air Temperature (Observed)



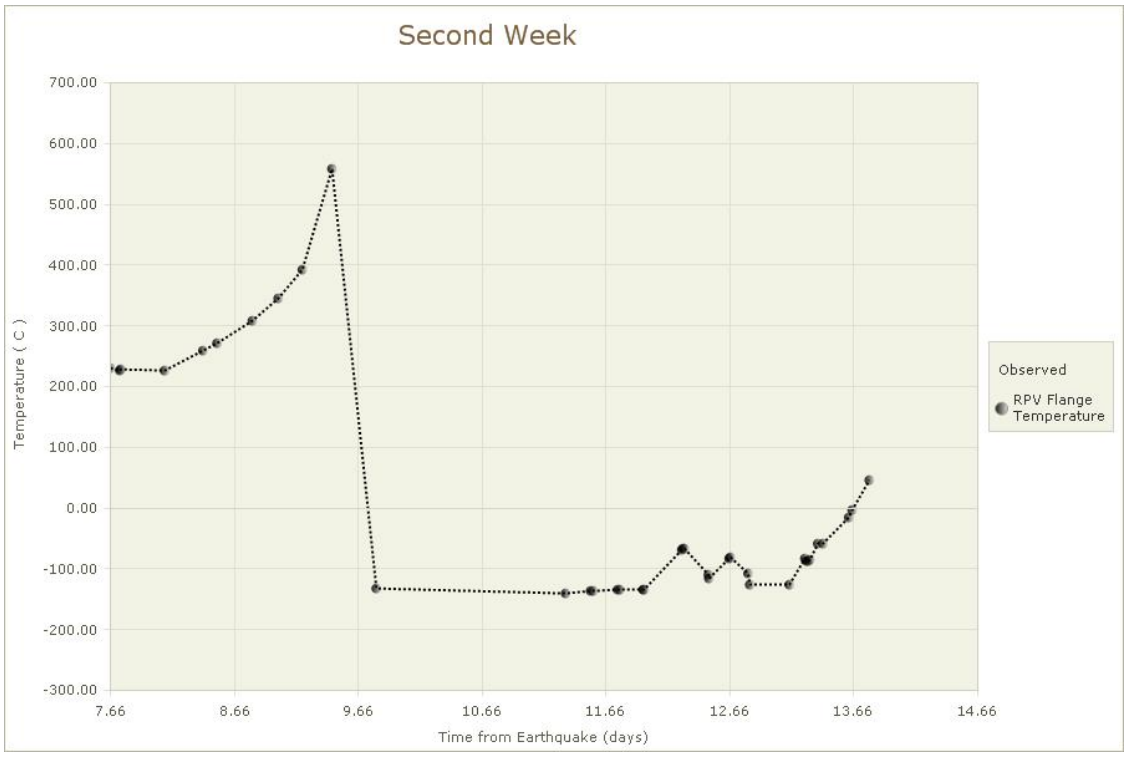
Unit3 Feedwater Nozzle N4B Temperature (Observed)



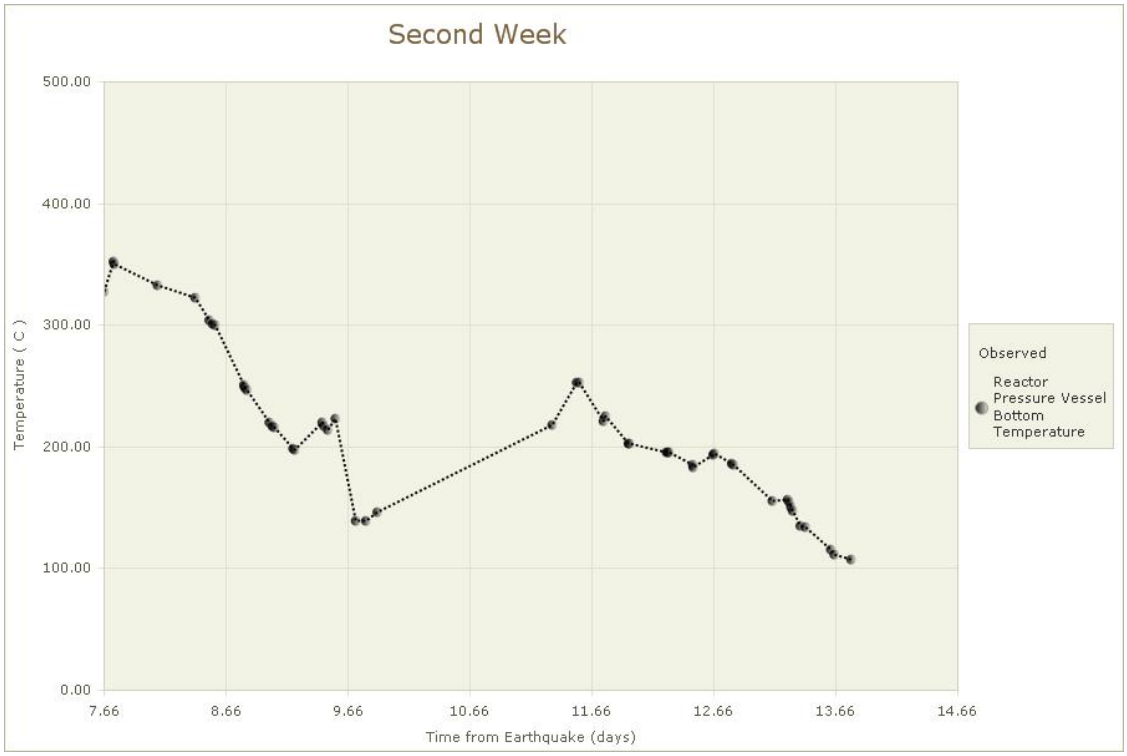
Unit3 RPV Bottom Head Temperature (Observed)



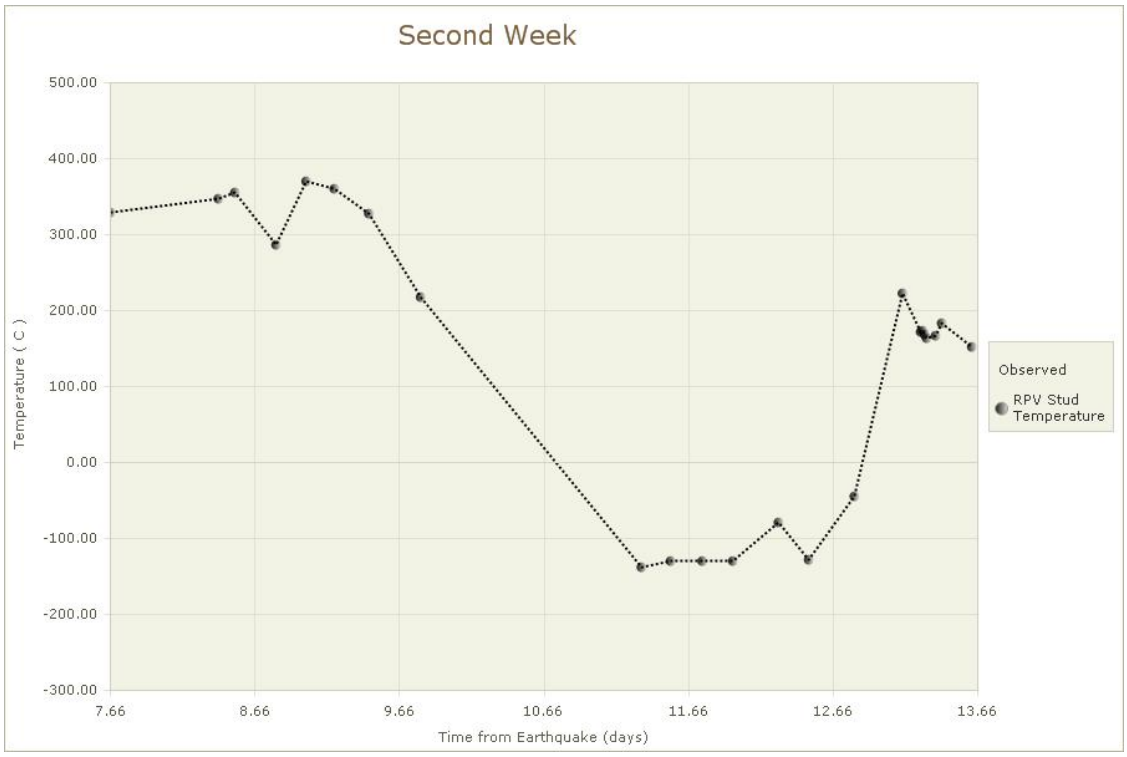
Unit3 RPV Flange Temperature (Observed)



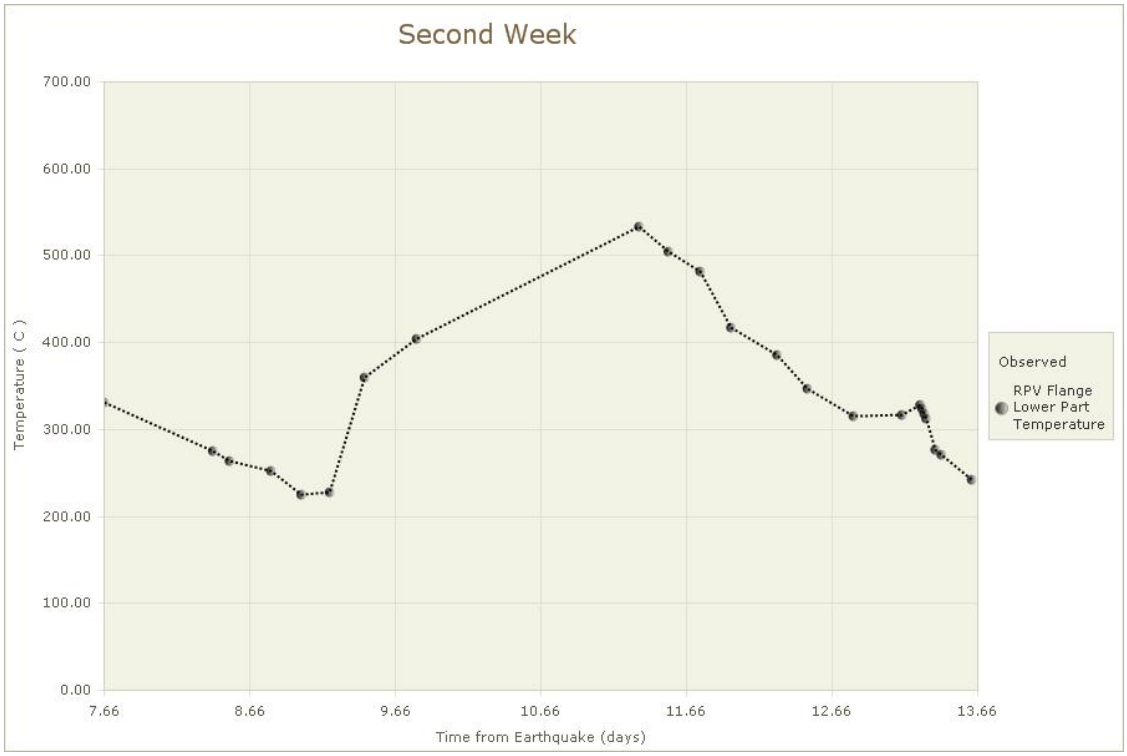
Unit3 Reactor Pressure Vessel Bottom Temperature (Observed)



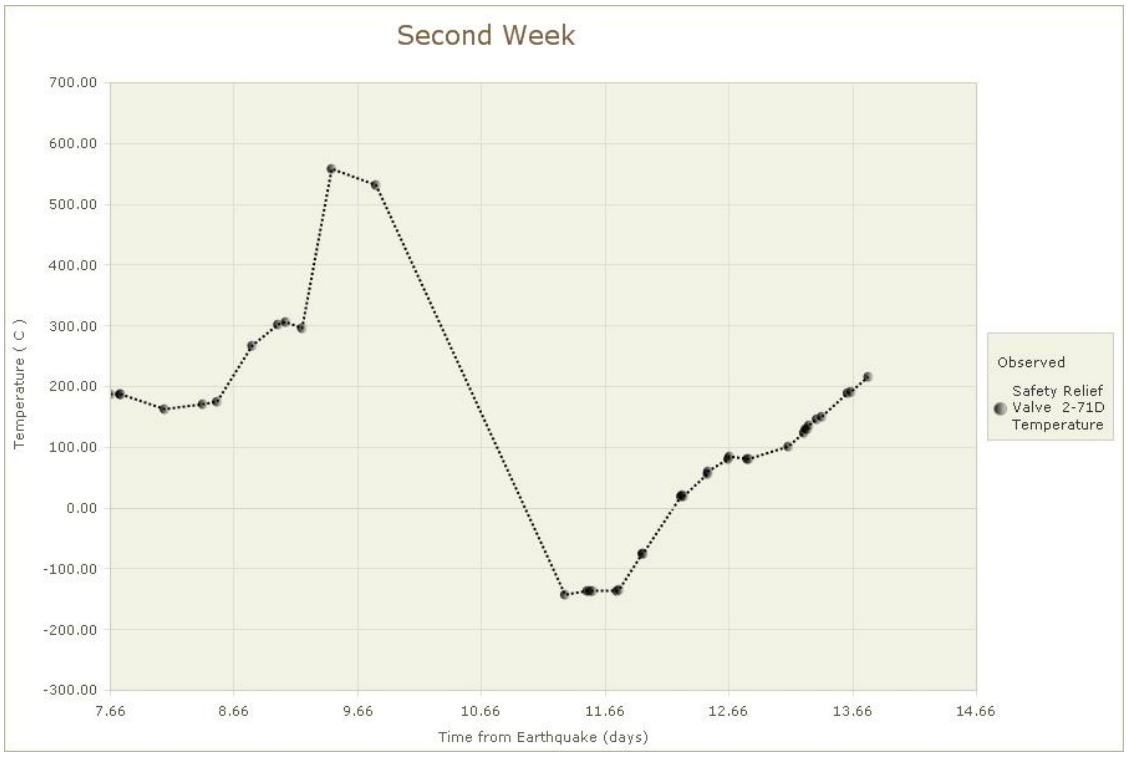
Unit3 RPV Stud Temperature (Observed)



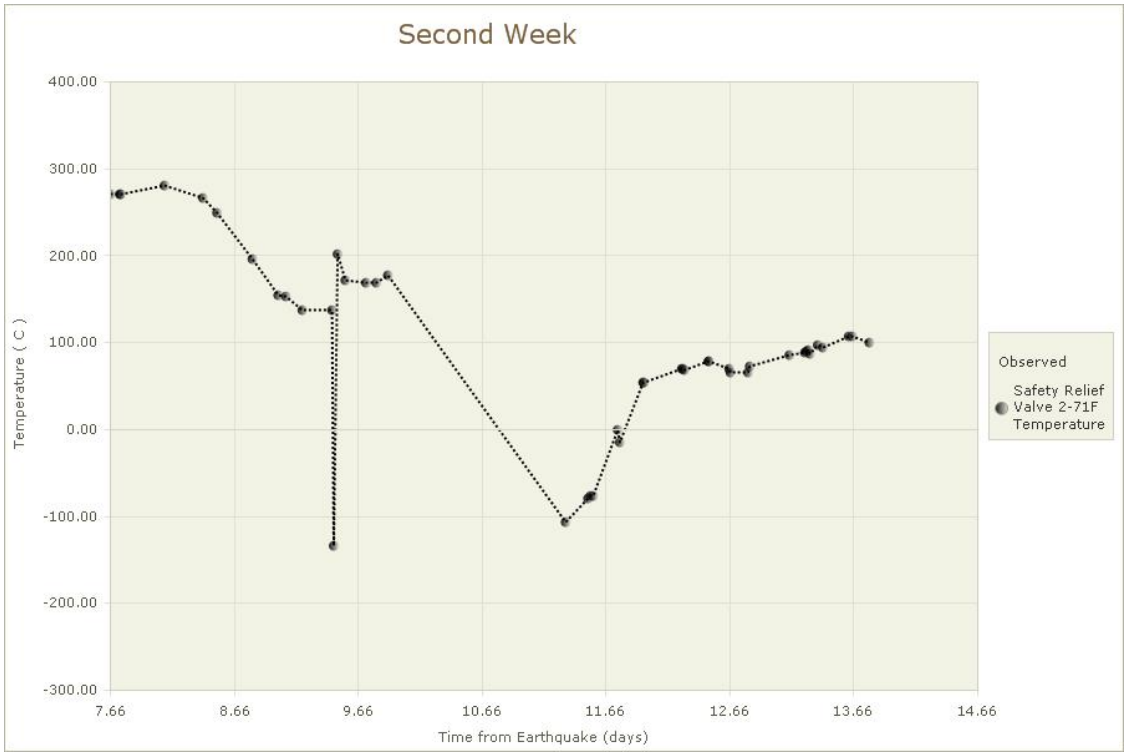
Unit3 RPV Flange Lower Part Temperature (Observed)



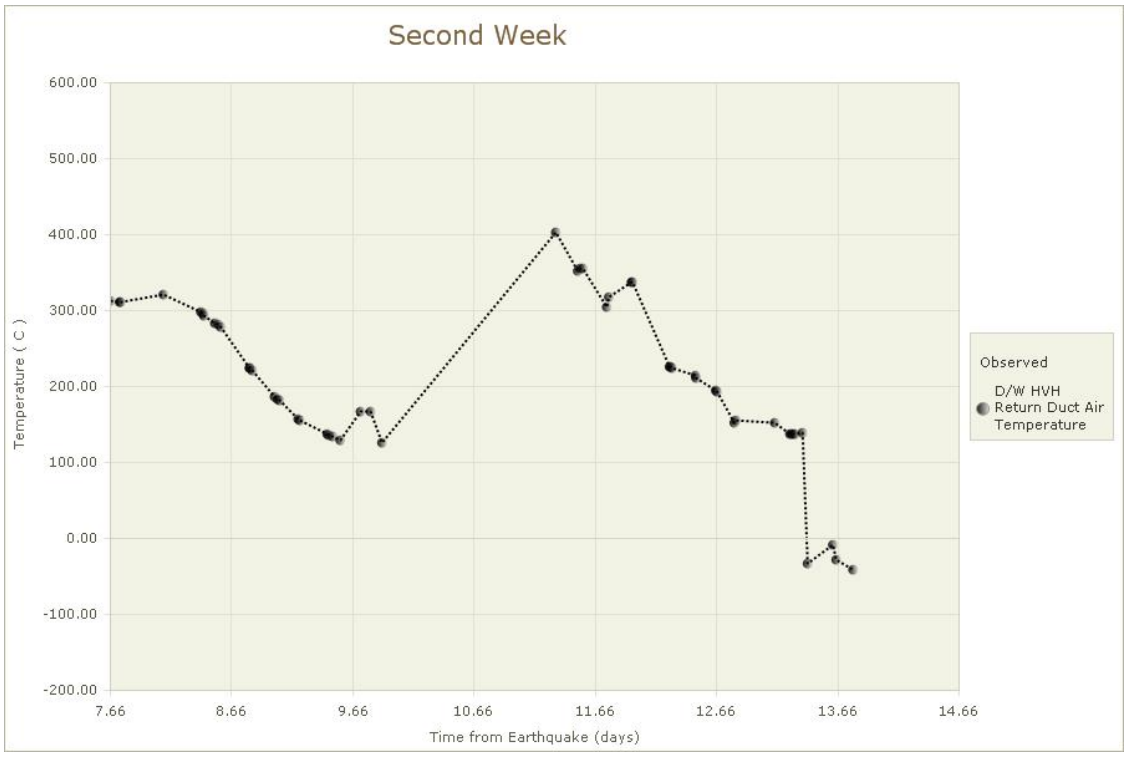
Unit3 Safety Relief Valve 2-71D Temperature (Observed)



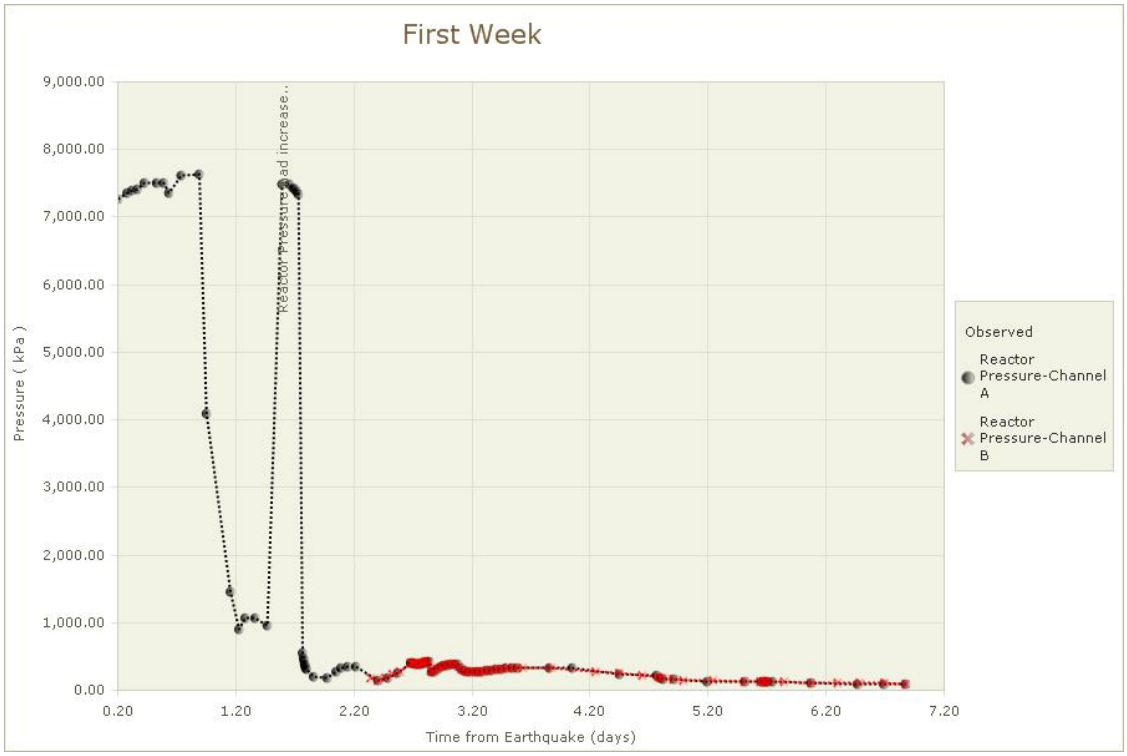
Unit3 Safety Relief Valve 2-71F Temperature (Observed)

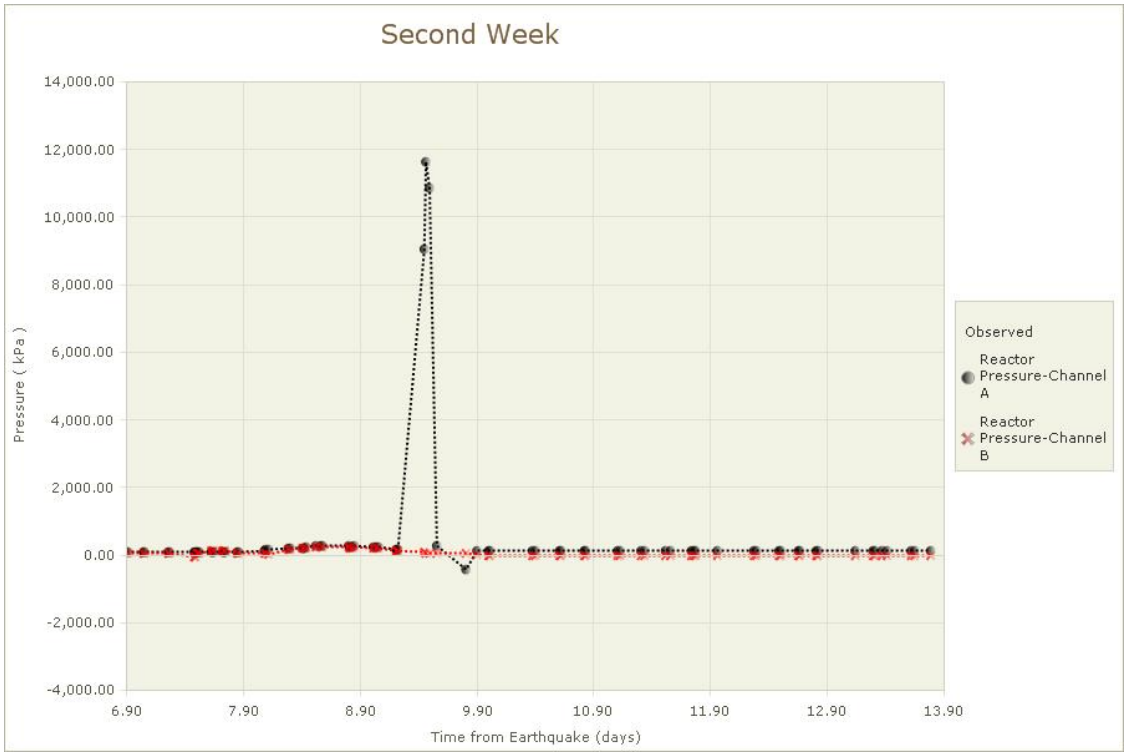


Unit3 D/W HVH Return Duct Air Temperature (Observed)

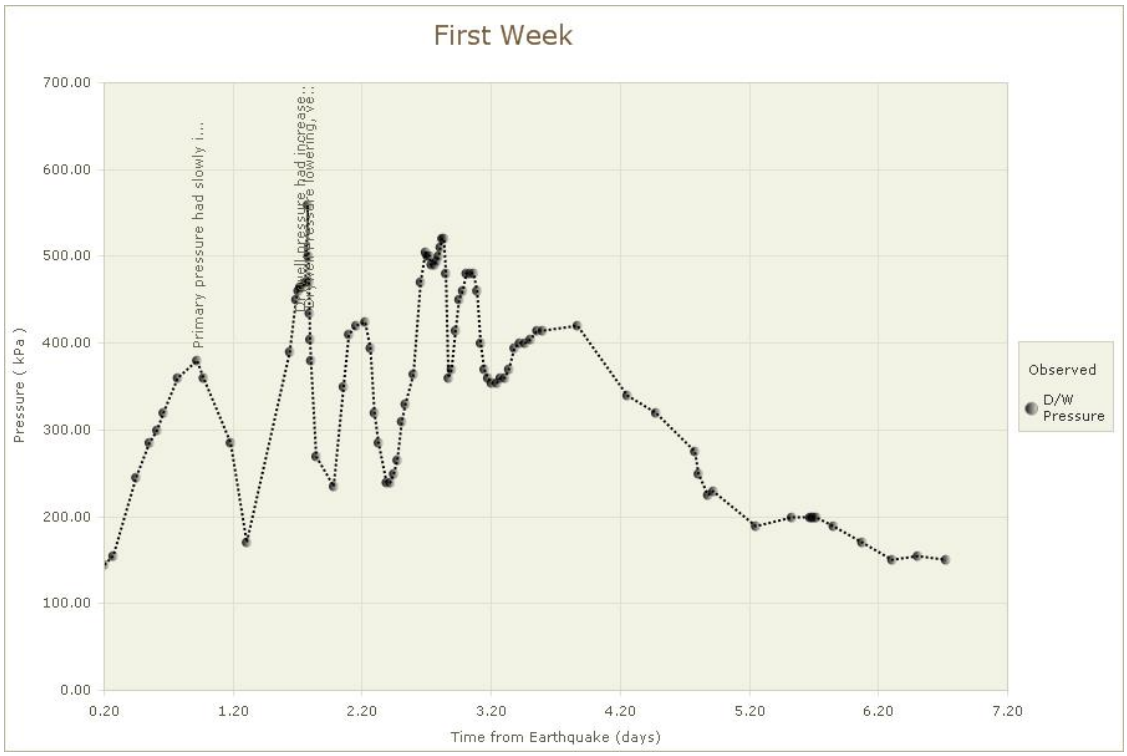


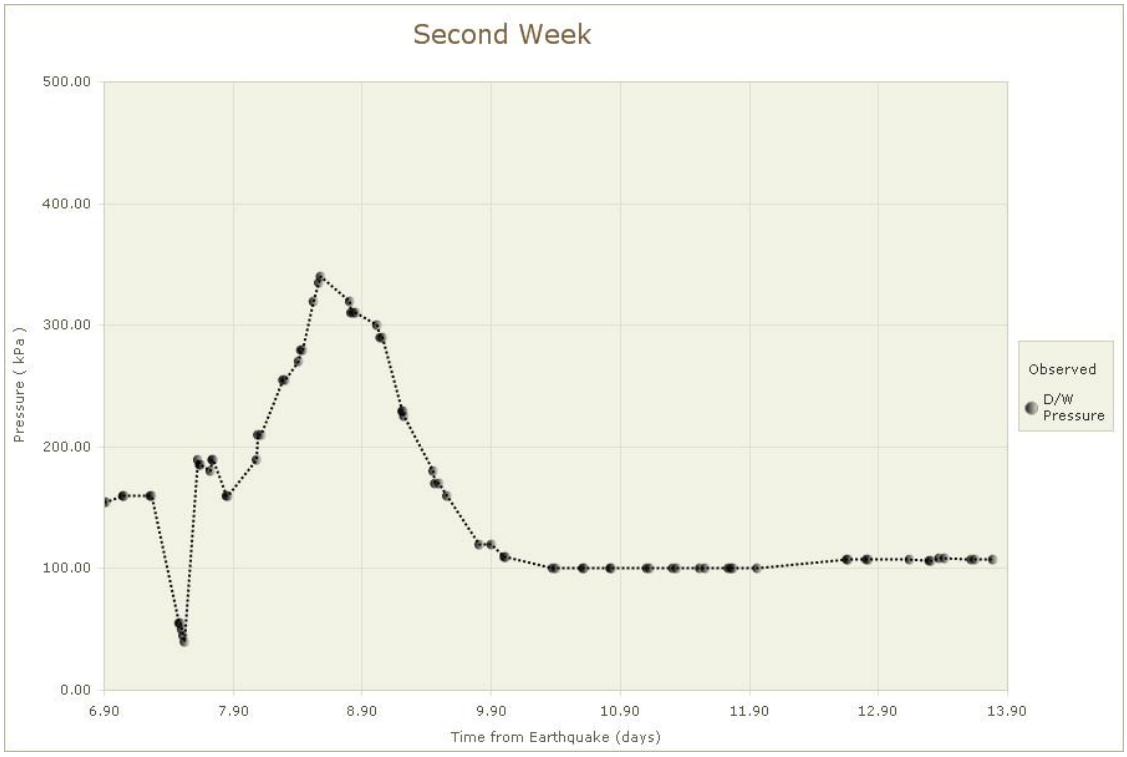
Unit3 Reactor Pressure (Observed)



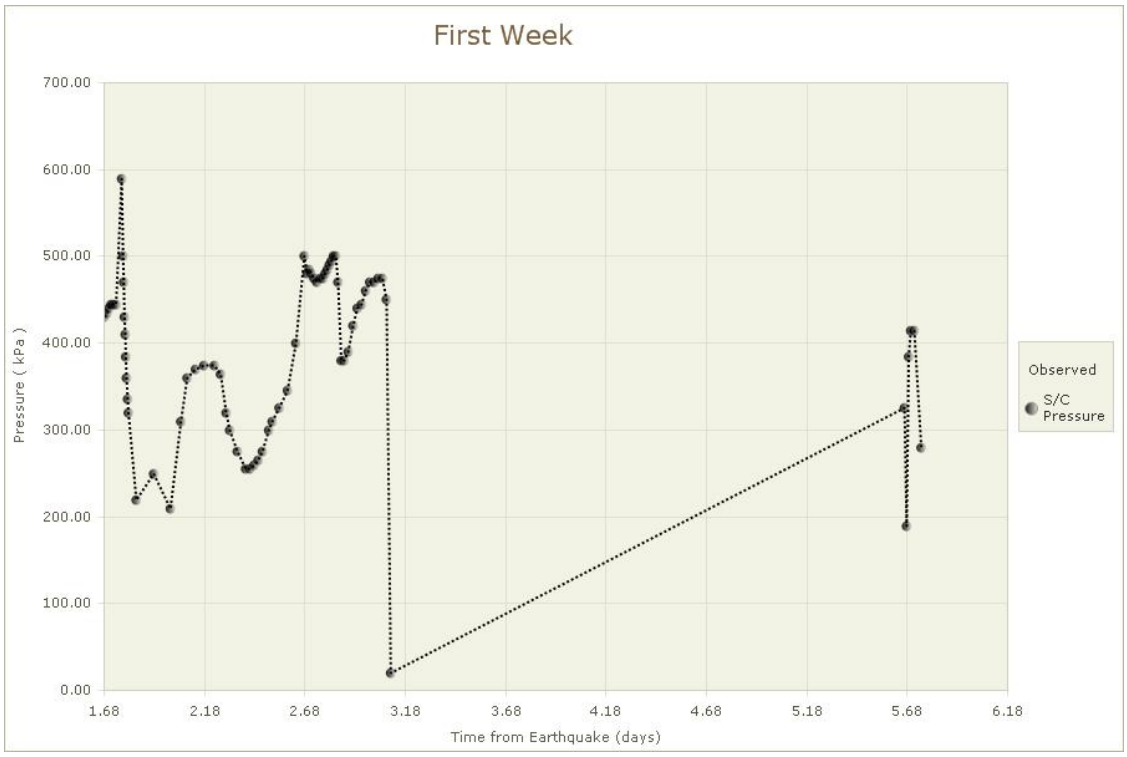


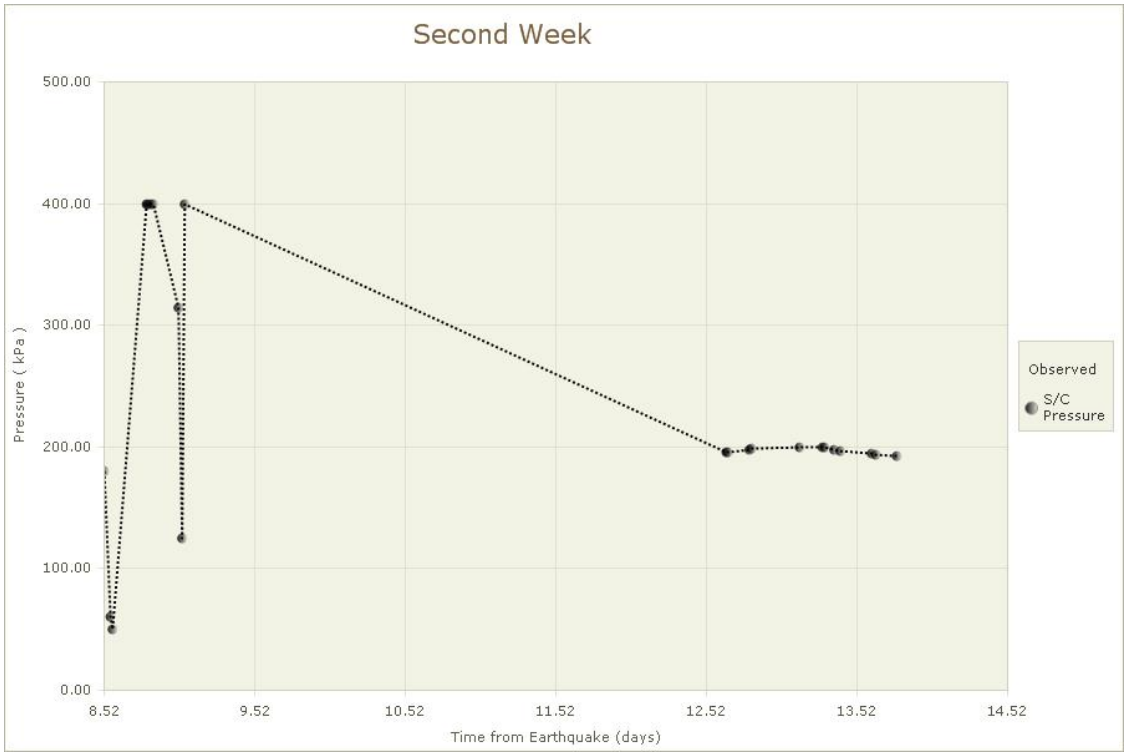
Unit3 D/W Pressure (Observed)





Unit3 S/C Pressure (Observed)




Second Week
500.00
400.00
300.00
200.00
100.00
0.00
Pressure (kPa)
8.52
9.52
10.52
11.52
12.52
13.52
14.52
Time from Earthquake (days)
Observed
S/C Pressure

Appendix A

Unit 1 Detailed Timeline

Friday, March 11, 2011

12:00:00 PM Isolation Condenser - Actuation Train - IC A
Standby

12:00:00 PM High Pressure Coolant Injection - Turbine driven pump - HPCI
Standby

12:00:00 PM Service Water System - Motor driven pump - CCSW
Operating

12:00:00 PM DC Power - Battery - 125 V Battery
Operating

12:00:00 PM Power Conversion - Main steam isolation valve - MSIVs
Normally Open; Not failed

12:00:00 PM Offsite Electrical Power - System level event - Offsite Power Sources
Operating

12:00:00 PM Reactor Protection - Actuation Train - Reactor
Operating

12:00:00 PM AC Power System - Emergency diesel generator - EDG 2
Standby

12:00:00 PM AC Power System - Emergency diesel generator - EDG 1
Standby

2:46:00 PM Earthquake (Tohoku)
A major earthquake occurred located off the coast of the Miyagi Prefecture.
Cause: Earthquake

2:46:00 PM Unit 1 Shut Down
Reactor Scram, Turbine Trip, all control rods fully inserted.
Cause: Automated Action

2:46:01 PM Reactor Protection - Actuation Train - Reactor
Reactor Scram

2:47:00 PM Offsite Electrical Power - System level event - Offsite Power Sources
No power-loss of power

2:47:00 PM Power Conversion - Main steam isolation valve - MSIVs
Normally open; fail in closed position

2:47:00 PM AC Power System - Emergency diesel generator - EDG 2
Automatically Started

2:47:00 PM AC Power System - Emergency diesel generator - EDG 1
Automatically Started

2:47:00 PM Loss of Offsite Power

Loss of all offsite power sources.
Cause: Loss of Power
2:52:00 PM Isolation Condenser - Actuation Train - IC B
Automatically Started
2:52:00 PM Isolation Condenser - Actuation Train - IC A
Automatically Started
3:02:00 PM Unit 1 subcriticality confirmed
Reactor subcriticality confirmed.
Cause: Operator Action
3:03:00 PM Isolation Condenser - Actuation Train - IC B
Manually Shutdown
3:03:00 PM Isolation Condenser - Actuation Train - IC A
Manually Shutdown
3:27:00 PM 1st Tsunami wave hits unit 1
Tsunami Wave generated by the earthquake strikes the plant
Cause: Earthquake
3:35:00 PM 2nd Tsunami wave hits unit 1
Tsunami Wave generated by the earthquake strikes the plant
Cause: Earthquake
3:37:00 PM High Pressure Coolant Injection - Turbine driven pump - HPCI
Fail to start
3:37:00 PM Service Water System - Motor driven pump - CCSW
Fail to continue running
3:37:00 PM DC Power - Battery - 125 V Battery
Fail to operate
3:37:00 PM AC Power System - Emergency diesel generator - EDG 2
Fail to continue running
3:37:00 PM AC Power System - Emergency diesel generator - EDG 1
Fail to continue running
3:37:00 PM Station Blackout, Unit 1
Loss of off site and on site AC power sources
Cause: Tsunami Flooding
5:30:00 PM Firewater Injection - Engine driven pump - Diesel driven fire pump
Manually Started
6:18:00 PM Isolation Condenser - Actuation Train - IC A
Manually Started
6:25:00 PM Isolation Condenser - Actuation Train - IC A
Manually Shutdown
8:07:00 PM Reactor pressure checked locally in reactor building, 1015 psia
Data indicated event: Reactor Pressure Channel A (Observed) = 7001 (kPa)

8:49:00 PM MCR lit by temporary lighting
Main Control Room lit by temporary lighting.
Cause: Operator Action
9:30:00 PM Isolation Condenser - Actuation Train - IC A
Manually Started
11:50:00 PM Restoration team provides temp power to MCR. D/W pressure 87 psia (600 kPaa)
Data indicated event: D/W Pressure (Observed) = 0.6 (kPa)

Saturday, March 12, 2011

1:48:00 AM Firewater Injection - Engine driven pump - Diesel driven fire pump
Fail to continue running
2:30:00 AM Drywell pressure had increased to 122 psia (.84 MPaa).
Data indicated event: D/W Pressure (Observed) = 0.84 (MPa)
2:45:00 AM Reactor pressure checked, 131 psia (901 kPaa)
Data indicated event: Reactor Pressure Channel A (Observed) = 901 (kPa)
4:19:00 AM Drywell pressure lowered and stabilized without venting to 113 psia(.78 MPaa)
Data indicated event: D/W Pressure (Observed) = 0.78 (MPa)
5:46:00 AM Firewater Injection - Engine driven pump - Fire Engine
Manually Started
11:00:00 AM Isolation Condenser - Actuation Train - IC A
Fail to continue running
2:30:00 PM Containment Vent - Air operated valve - S/C Large vent valve
Manually Opened
2:30:00 PM Venting Suppression Chamber began
Opened large suppression chamber vent valve with temporary air compressor. Release of radioactive material and decrease in containment pressure confirmed.
Cause: Operator Action
2:50:00 PM Drywell pressure decreases, indicating venting successful.
Data indicated event: D/W Pressure (Observed) = 0.58 (MPa)
2:53:00 PM Firewater Injection - Engine driven pump - Fire Engine
Loss of function
3:36:00 PM Hydrogen Explosion
Hydrogen Explosion in the Unit 1 Reactor Building
Cause: Explosion
7:04:00 PM Firewater Injection - Engine driven pump - Fire Engine
Manually Started
8:45:00 PM Boric acid added to seawater
Commenced adding boric acid to seawater injection
Cause: Operator Action

Unit 2 Detailed Timeline

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12:00:00 PM High Pressure Coolant Injection - Turbine driven pump - HPCI
Standby

12:00:00 PM Residual Heat Removal Service Water - Motor driven pump - RHRS
Standby

12:00:00 PM Service Water System - Motor driven pump - CCSW
Operating

12:00:00 PM DC Power - Battery - 125 V Battery
Operating

12:00:00 PM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system
Standby

12:00:00 PM Offsite Electrical Power - System level event - Offsite Power Sources
Operating

12:00:00 PM Power Conversion - Main steam isolation valve - MSIVs
Normally Open; Not failed

12:00:00 PM Reactor Protection - Actuation Train - Reactor
Operating

12:00:00 PM AC Power System - Emergency diesel generator - EDG 2
Standby

12:00:00 PM AC Power System - Emergency diesel generator - EDG 1
Standby

2:46:00 PM Earthquake (Tohoku)
A major earthquake occurred located off the coast of the Miyagi Prefecture.
Cause: Earthquake

2:47:00 PM Offsite Electrical Power - System level event - Offsite Power Sources
No power-loss of power

2:47:00 PM Power Conversion - Main steam isolation valve - MSIVs
Normally open; fail in closed position

2:47:00 PM Reactor Protection - Actuation Train - Reactor
Reactor Scram

2:47:00 PM AC Power System - Emergency diesel generator - EDG 2
Automatically Started

2:47:00 PM AC Power System - Emergency diesel generator - EDG 1
Automatically Started

2:47:00 PM Loss of Offsite Power
Loss of all offsite power sources.
Cause: Loss of Power

2:47:00 PM Unit 2 Shutdown

Reactor Scram, Turbine Trip, all control rods fully inserted.
Cause: Automated Action

2:50:00 PM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system
Manually Started

2:51:00 PM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system
Automatically Shutdown

3:00:00 PM Residual Heat Removal Service Water - Motor driven pump - RHRS
Manually Started

3:01:00 PM Unit 2 subcriticality confirmed
Unit 2 reactor confirmed to be subcritical.
Cause: Operator Action

3:02:00 PM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system
Manually Started

3:07:00 PM Torus cooling placed in service
Torus cooling manually started.
Cause: Operator Action

3:25:00 PM Torus spray placed in service
Torus spray manually started.
Cause: Operator Action

3:27:00 PM 1st Tsunami wave hits unit 2
Tsunami Wave generated by the earthquake strikes the plant
Cause: Earthquake

3:28:00 PM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system
Automatically Shutdown

3:35:00 PM 2nd Tsunami wave hits unit 2
Tsunami Wave generated by the earthquake strikes the plant
Cause: Earthquake

3:39:00 PM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system
Manually Started

3:41:00 PM High Pressure Coolant Injection - Turbine driven pump - HPCI
Fail to start

3:41:00 PM Residual Heat Removal Service Water - Motor driven pump - RHRS
Fail to continue running

3:41:00 PM Service Water System - Motor driven pump - CCSW
Fail to continue running

3:41:00 PM DC Power - Battery - 125 V Battery
Fail to operate

3:41:00 PM AC Power System - Emergency diesel generator - EDG 2
Fail to continue running

3:41:00 PM AC Power System - Emergency diesel generator - EDG 1

Fail to continue running

3:41:00 PM Station Blackout, Unit 2

Loss of off site and on site AC power.

Cause: Tsunami Flooding

8:49:00 PM MCR lit by temporary lighting

Main control room lit by temporary lighting

Cause: Operator Action

9:50:00 PM Reactor water level 3,400 mm > TAF

Reactor water level indication restored in control room. Vessel level indicated 3,400 mm above TAF.

Cause: Operator Action

11:25:00 PM Drywell pressure indication restored. DW pressure 20 psia (.141 MPaa)

Data indicated event: D/W Pressure (Observed) = 0.141 (MPa)

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2:00:00 AM RCIC verified to be operating

Workers verified RCIC pump discharge pressure in the field.

Cause: Operator Action

4:20:00 AM RCIC suction swapped (CST to torus)

RCIC suction was swapped from the CST to the torus.

Cause: Operator Action

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1:18:00 PM Reactor water level 2400 mm > TAF

Reactor water level was 2400 mm above TAF and trending downward.

Cause: Operator Action

1:25:11 PM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system

Fail to continue running

4:43:00 PM Below Top of Active Fuel (TAF)

Data indicated event: Reactor Vessel Level Fuel Zone, A (Observed) = -0.3 (m)

5:12:00 PM Reactor Pressure 1088 psia, too high for seawater injection

Data indicated event: Reactor Pressure Channel A (Observed) = 7.504 (MPa)

5:17:00 PM Reactor water level decreased to TAF

Indicated reactor water level decreased to TAF.

Cause: Loss of Power

6:03:00 PM Reactor depressurization begins

Data indicated event: Reactor Pressure Channel A (Observed) = 6.176 (MPa)

6:06:00 PM Main Steam - Safety relief valve - SRV

Manually Opened

6:30:00 PM Firewater Injection - Engine driven pump - Fire Engine

Manually Started

7:03:00 PM Reactor pressure stabilizes following depressurization

Data indicated event: Reactor Pressure Channel A (Observed) = 0.731 (MPa)

7:20:00 PM Firewater Injection - Engine driven pump - Fire Engine
Fail to continue running

7:54:00 PM Firewater Injection - Engine driven pump - Fire Engine
Manually Started

9:03:00 PM Reactor pressure increasing
Data indicated event: Reactor Pressure Channel A (Observed) = 1.519 (MPa)

9:20:00 PM Main Steam - Safety relief valve - SRV
Manually Opened

10:50:00 PM Drywell pressure exceeds design pressure
Data indicated event: D/W Pressure (Observed) = 0.54 (MPa)

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12:45:00 AM Injection not likely at this pressure
Data indicated event: Reactor Pressure Channel A (Observed) = 1.924 (MPa)

6:00:00 AM Loud Noise Reported
A loud noise was heard. Possibly in the area of the torus (Unit 2) or from the explosions in Unit 4.
Cause: Unknown

11:25:00 AM Drywell pressure decreased, likely related to loud noise heard at 0600
Data indicated event: D/W Pressure (Observed) = 0.155 (MPa)

Unit 3 Detailed Timeline

Friday, March 11, 2011

12:00:00 PM DC Power - Battery - 125 V Battery
Operating

12:00:00 PM High Pressure Coolant Injection - Turbine driven pump - HPCI
Standby

12:00:00 PM Residual Heat Removal Service Water - Motor driven pump - RHRS
Standby

12:00:00 PM Service Water System - Motor driven pump - CCSW
Operating

12:00:00 PM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system
Standby

12:00:00 PM Power Conversion - Main steam isolation valve - MSIVs
Normally Open; Not failed

12:00:00 PM Offsite Electrical Power - System level event - Offsite Power Sources
Operating

12:00:00 PM Reactor Protection - Actuation Train - Reactor
Operating

12:00:00 PM AC Power System - Emergency diesel generator - EDG 2

Standby
12:00:00 PM AC Power System - Emergency diesel generator - EDG 1
Standby
2:46:00 PM Earthquake (Tohoku)
A major earthquake occurred located off the coast of the Miyagi Prefecture.
Cause: Earthquake
2:47:00 PM Offsite Electrical Power - System level event - Offsite Power Sources
No power-loss of power
2:47:00 PM Reactor Protection - Actuation Train - Reactor
Reactor Scram
2:47:00 PM AC Power System - Emergency diesel generator - EDG 2
Automatically Started
2:47:00 PM AC Power System - Emergency diesel generator - EDG 1
Automatically Started
2:47:00 PM Loss of Offsite Power
Loss of all offsite power sources.
Cause: Loss of Power
2:47:00 PM Unit 3 Shutdown
Reactor scram, turbine trip, all control rods fully inserted.
Cause: Automated Action
2:48:00 PM Power Conversion - Main steam isolation valve - MSIVs
Normally open; fail in closed position
2:54:00 PM Unit 3 subcriticallity confirmed
Unit 3 reactor verified subcritical
Cause: Operator Action
3:05:00 PM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system
Manually Started
3:25:00 PM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system
Automatically Shutdown
3:27:00 PM 1st Tsunami Wave hits Unit 3
Tsunami Wave generated by the earthquake strikes the plant
Cause: Earthquake
3:35:00 PM 2nd Tsunami Wave hits unit 3
Tsunami Wave strikes plant
Cause: Earthquake
3:38:00 PM Station Blackout, Unit 3
Loss of both offsite and onsite AC power sources.
Cause: Tsunami Flooding
3:41:00 PM Residual Heat Removal Service Water - Motor driven pump - RHRS
Fail to start

3:41:00 PM Service Water System - Motor driven pump - CCSW
Fail to continue running
3:41:00 PM AC Power System - Emergency diesel generator - EDG 2
Fail to continue running
3:41:00 PM AC Power System - Emergency diesel generator - EDG 1
Fail to continue running
4:03:00 PM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system
Manually Started
9:58:00 PM Temporary lighting for unit 3 MCR
Temporary lighting established for unit 3 main control room using portable generator.
Cause: Operator Action

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11:36:00 AM Reactor Core Isolation Cooling - Turbine driven pump - RCIC system
Fail to continue running
12:10:00 PM Primary pressure had slowly increased to 57 psia (0.39 MPaa)
Data indicated event: D/W Pressure (Observed) = 0.39 (MPa)
12:35:00 PM High Pressure Coolant Injection - Turbine driven pump - HPCI
Automatically Started
9:30:00 PM DC Power - Battery - 125 V Battery
Fail to operate

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2:42:00 AM High Pressure Coolant Injection - Turbine driven pump - HPCI
Fail to continue running
5:00:00 AM Reactor Pressure had increased to 1,085 psia (7.48 MPa abs).
Data indicated event: Reactor Pressure Channel A (Observed) = 7.481 (MPa)
7:45:00 AM Drywell pressure had increased to 67 psia (.46 Mpaa)
Data indicated event: D/W Pressure (Observed) = 0.46 (MPa)
9:08:00 AM Main Steam - Safety relief valve - SRV
Manually Opened
9:20:00 AM Containment Vent - Air operated valve - S/C Large vent valve
Manually Opened
9:20:00 AM Venting determined to have started.
Venting determined to have successfully started due to decreasing containment pressure.
Cause: Operator Action
9:24:00 AM Drywell Pressure lowering, venting successful.
Data indicated event: D/W Pressure (Observed) = 0.54 (MPa)
9:25:00 AM Firewater Injection - Engine driven pump - Fire Engine
Manually Started
11:17:00 AM Containment Vent - Air operated valve - S/C Large vent valve
Normally closed; fail in the closed position

12:20:00 PM Firewater Injection - Engine driven pump - Fire Engine
Fail to continue running
12:30:00 PM Containment Vent - Air operated valve - S/C Large vent valve
Manually Opened
1:12:00 PM Firewater Injection - Engine driven pump - Fire Engine
Manually Started
3:00:00 PM Containment Vent - Air operated valve - S/C Large vent valve
Normally closed; fail in the closed position
8:10:00 PM Containment Vent - Air operated valve - S/C Large vent valve
Manually Opened

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1:00:00 AM Containment Vent - Air operated valve - S/C Large vent valve
Normally closed; fail in the closed position
1:10:00 AM Firewater Injection - Engine driven pump - Fire Engine
Fail to continue running
3:20:00 AM Firewater Injection - Engine driven pump - Fire Engine
Manually Started
6:10:00 AM S/C small vent valve opened
S/C small vent valve confirmed to have been opened, however containment pressure readings indicate little if any venting resulted.
Cause: Operator Action
11:01:00 AM Firewater Injection - Engine driven pump - Fire Engine
Fail to continue running
11:01:00 AM Hydrogen Explosion
Hydrogen Explosion in the Unit 3 Reactor Building
Cause: Explosion
4:30:00 PM Firewater Injection - Engine driven pump - Fire Engine
Manually Started

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4:05:00 PM Containment Vent - Air operated valve - S/C Large vent valve
Manually Opened

Unit 4 Detailed Timeline

Friday, March 11, 2011

12:00:00 PM Unit 4 Initial Condition
Unit 4 was in an outage with the core offloaded to the spent fuel pool.
2:46:00 PM Earthquake (Tohoku)
A major earthquake occurred located off the coast of the Miyagi Prefecture.
Cause: Earthquake
2:47:00 PM Loss of Offsite Power

Loss of all offsite power sources.
Cause: Loss of Power

3:38:00 PM Station Blackout, Unit 4
Loss of all onsite and offsite AC power.
Cause: Tsunami Flooding

Tuesday, March 15, 2011

6:00:00 AM Explosion in Unit 4 reactor building
An explosion occured in the unit 4 reactor building. It is assumed to be caused by Hydrogen from venting unit 3.
Cause: Explosion

6:00:00 AM Loud Noise Reported
A loud noise was heard. Possibly in the area of the torus (Unit 2) or from the explosions in Unit 4.
Cause: Unknown

Unit 5 Detailed Timeline

Friday, March 11, 2011

12:00:00 PM Initial Conditions of Unit 5
Unit 5 was in an outage with fuel assemblies in the core and RPV intact.

2:46:00 PM Earthquake (Tohoku)
A major earthquake occurred located off the coast of the Miyagi Prefecture.
Cause: Earthquake

2:47:00 PM Loss of Offsite Power
Loss of all offsite power sources.
Cause: Loss of Power

3:40:00 PM Station blackout, Unit 5
Loss of all onsite and offsite AC power sources.
Cause: Tsunami Flooding

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2:30:00 PM Unit 5 Achieves Cold Shutdown
Unit 5 reaches cold shutdown conditions
Cause: Operator Action

Unit 6 Detailed Timeline

Friday, March 11, 2011

12:00:00 PM Initial Conditions of Unit 6
Unit 6 was in an outage with all fuel assemblies loaded in the core and in cold shutdown mode.

2:46:00 PM Earthquake (Tohoku)
A major earthquake occurred located off the coast of the Miyagi Prefecture.
Cause: Earthquake

2:47:00 PM Loss of Offsite Power

Loss of all offsite power sources.

Cause: Loss of Power

3:40:00 PM EDG status after Tsunami

After the Tsunami flooding, EDGs 6A and 6H failed. EDG 6B continued to run and provided AC power.

Cause: Tsunami Flooding

Sunday, March 20, 2011

7:27:00 PM Unit 6 achieves cold shutdown

Unit 6 reaches cold shutdown conditions

Cause: Operator Action